Accomplishments Report

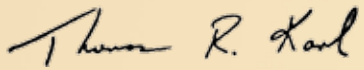
2010

NOAA's National Climatic Data Center

FROM THE DIRECTOR

2010 stands out as an exciting year for NOAA's National Climatic Data Center. NCDC remains the world's largest archive of climate information and provides a suite of climate monitoring and data services to the Nation. In 2010, NCDC's archive grew from 4 to 5.0 petabytes. Written as 5,000,000,000,000,000 bytes, 5.0 petabytes is equivalent to over 66.5 years of HD television shows played without repeating. NCDC also delivered 1,260 terabytes of data electronically to users. This was an 87 percent increase over 675 terabytes delivered in 2009. NCDC had over 850 million website hits in 2010 as users accessed key climate information and data. As the importance of climate information to make decisions in areas such as agriculture, energy, and city planning grows, NCDC continues to increase its suite of climate services for the nation. In 2010, NCDC released the first three operational Climate Data Records – which take decades of satellite-based weather observations and turn the data into sustainable long-term climate records. This past year, NCDC also introduced six new Regional Climate Service Directors committed to building and strengthening regional partnerships to better assess and deliver regionally-focused climate science and information products and services.

The following pages highlight these and other key accomplishments from NCDC as we carry out critical climate science, develop new and better applications to enable climate data access, and monitor our changing planet. None of this work could be accomplished without the dedication of NCDC staff and team members, and the collaboration with our partner, the Cooperative Institute for Climate and Satellites (CICS). This world-class team dedicates itself to better understand the state of our climate for you and the Nation and preserving climate information for generations to come.



Thomas R. Karl, L.H.D.
NCDC Director

TEAM WORK

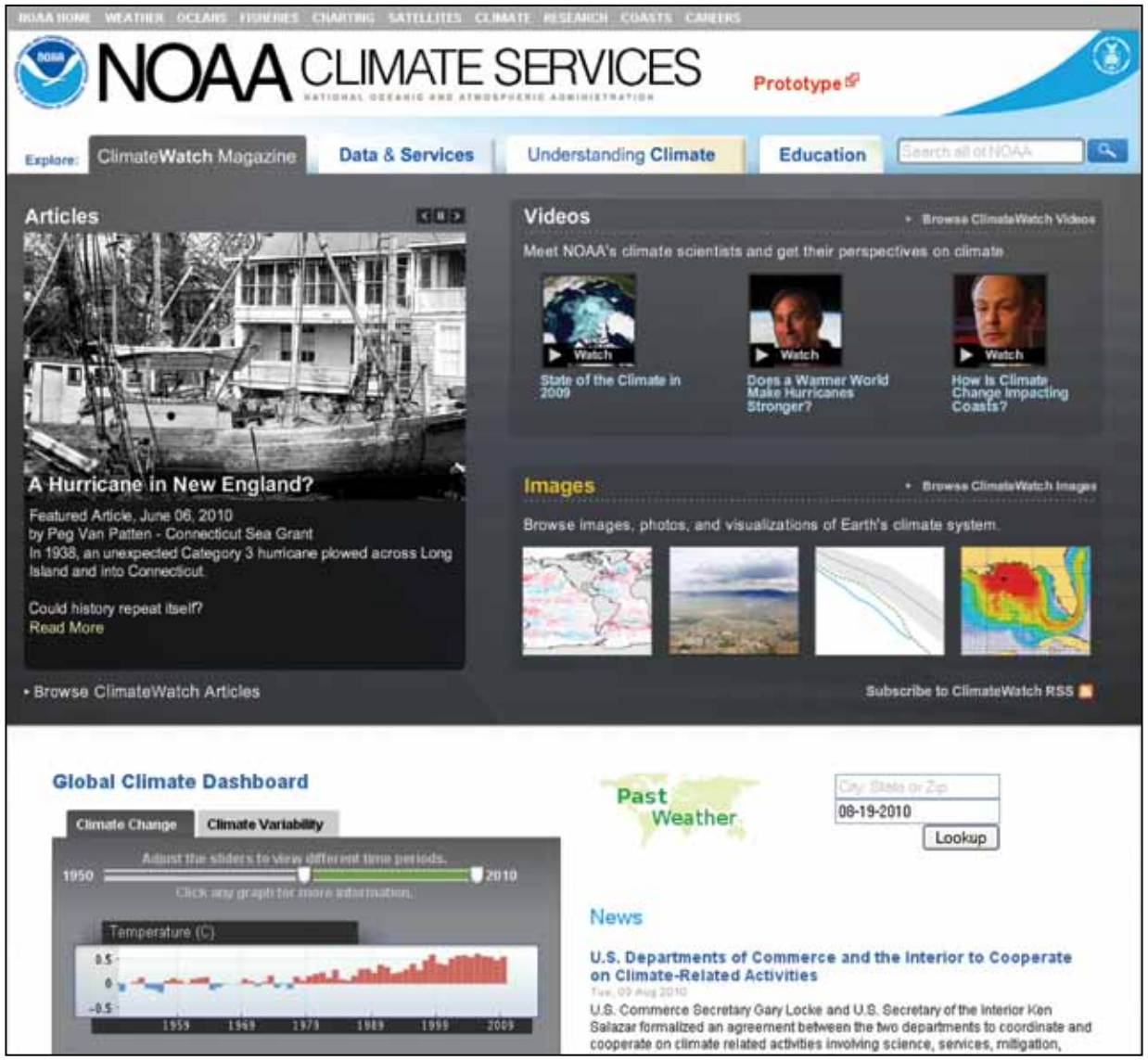
Chicago City Hall Green Roof (*photo courtesy of Tony The Tiger and Wikimedia Commons*)

©istockphotos.com/Alexey-Stiop

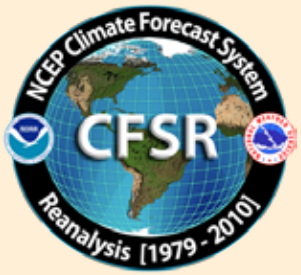
TABLE OF CONTENTS

PUBLIC RELEASE OF CLIMATE PORTAL

In February 2010, NOAA unveiled the Climate Portal (*climate.gov*) to the public, marking a new era for user-focused access to NOAA climate data and services. As co-lead of a NOAA cross-agency team, NCDC made significant contributions to the development of the portal in support of NOAA's responsibility to provide climate information for decision support and to build a climate-literate society. With disparate Web pages related to climate across the agency, NOAA's Internet presence lacked streamlined access to its state-of-the art climate science, observations and model output, monitoring products and services, and assessments. With a cross-agency team of managers, scientists, and software developers, the Climate Portal implemented a governance structure, exploiting existing resources across multiple line offices to rapidly develop an initial Web portal. The Climate Portal uses Web technologies to serve climate data and products in formats that are readily usable by large segments of society. The team utilized a testing and feedback process to collect input from a variety of stakeholders such as State Climatologists and Regional Climate Centers and customers, tailoring the Portal for a wide cross section of users. NCDC played a key role in the Portal development and is the Portal host. The Portal now provides customers a clearly defined central point of access for selected climate data, products, and services.



INGEST, ARCHIVE, AND ONLINE ACCESS FOR THE CLIMATE FORECAST SYSTEM REANALYSIS (CFSR)



CFSR Logo: Patrick Tripp, NWS/EMC

In pursuit of understanding environmental change and impact, scientists and decision makers are increasingly seeking information that will help their communities plan and respond to climate variability and change. Uninterrupted climate observations are not available for all times or at every place on Earth, so scientists use climate models to "reanalyze" the existing data to fill in the gaps. The resulting datasets, called reanalyses, allow for improved detection, analysis, and verification of climate indicators. Reanalysis data also improve scientists' abilities to determine climate variation attribution. In 2010, NCDC became the primary provider to the public of the next-generation, 30-year Climate Forecast System Reanalysis (CFSR) dataset. The CFSR dataset, developed by NOAA's National Center for Environmental Prediction (NCEP), is the first major reanalysis generated in over 10 years and users had requested easy access to the data. Once available via NCDC, CFSR data quickly became one of the most requested online datasets in NCDC's history. To transfer the data, NCDC worked with NCEP to establish secure means of transferring the over 200 terabytes, equal to 200,000 gigabytes, of data. The data were quality-controlled and then ingested into NCDC's IT storage system, called the Comprehensive Large-Array data Stewardship System (CLASS), and rapidly made available to customers via the National Operational Model Archive and Distribution System (NOMADS) user access system. NCDC then used the NOMADS infrastructure to provide a user-friendly suite of tools and Web-based services to allow easy public access to the data.

NCDC SCIENTIST ELECTED HEAD OF WORLD METEOROLOGICAL ORGANIZATION COMMISSION ON CLIMATOLOGY

The World Meteorological Organization (WMO), a specialized agency of the United Nations, relies on its Commission for Climatology "to provide world leadership in promoting expertise and international cooperation in climatology." At the Commission's meeting in February 2010, in Antalya, Turkey, formal representatives from 86 countries unanimously elected NCDC's Chief Scientist, Thomas Peterson, as President of the WMO Commission for Climatology to a four–year term. Dr. Peterson will represent the climate community across WMO. But his main task is guiding the activities of over 200 volunteers from 54 countries to fulfill the Commission's mission "to stimulate, lead, implement, assess and coordinate international technical activities within WMO under the World Climate Programme and the Global Framework for Climate Services to obtain and apply climate information and knowledge in support of sustainable socio-economic development and environmental protection." Many of the Commission's key activities advance global climate science and at the same time build capacity among participating countries to provide climate services to their citizens.

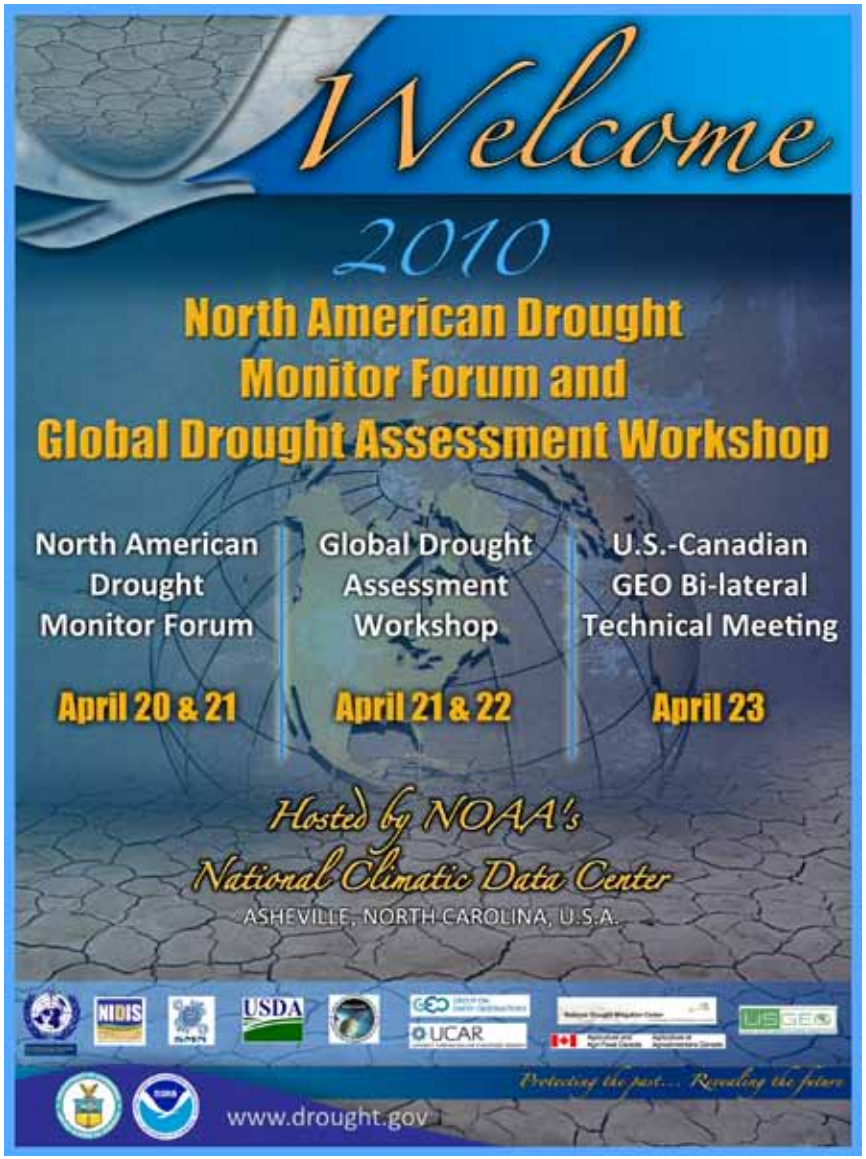
NCDC's Chief Scientist, Thomas Peterson

IMPROVING CLIMATE SERVICES ENGAGEMENT WITH BUSINESS SECTORS

NCDC teams developed business sector fact sheets that have been widely distributed for 12 areas covering: Agriculture, Civil Infrastructure, Coastal Hazards, Energy, Health, Insurance, Litigation, Marine and Coastal Ecosystems, National Security, Tourism, Transportation, and Water Resources. During 2010, sector team members participated in over 50 sectoral meetings and hosted or co-hosted nine workshops, interacting with users interested in climate data and applications in these sectors to better understand specific sector needs for climate information. This proactive approach increases NCDC's ability to provide relevant climate data to address specific sector needs. Sector customers, such as the reinsurance and agriculture industries, have noted that NCDC's data holdings and expertise enable them to make better business decisions, save money, improve their products, expand their businesses, and reduce their impact on the environment.

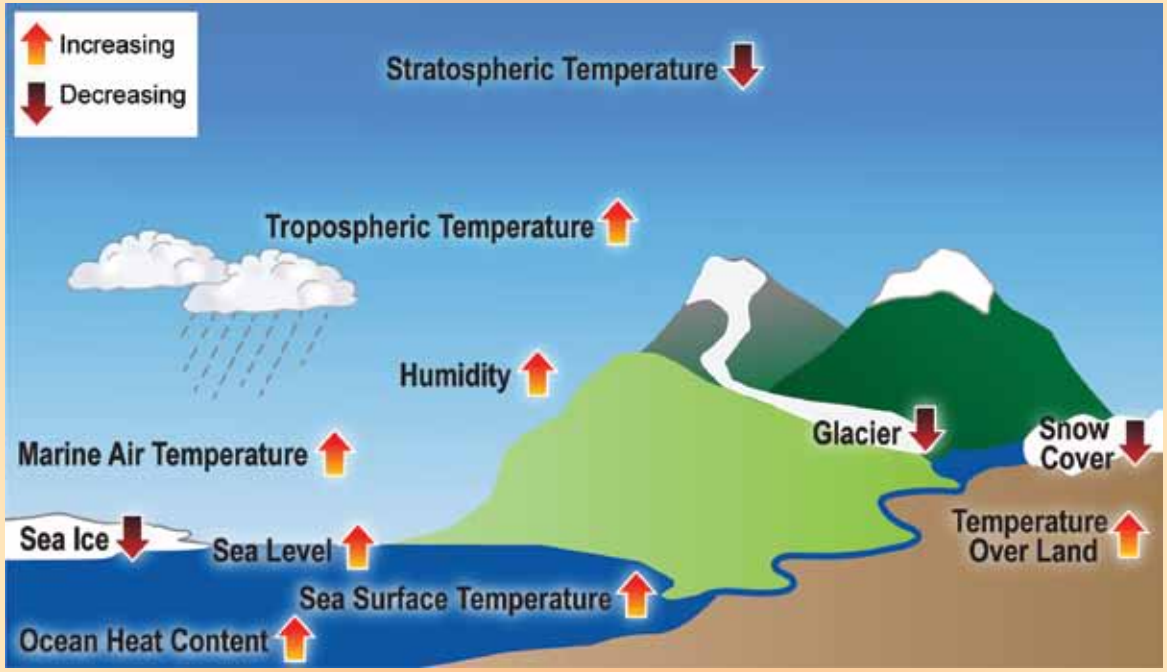
INTERNATIONAL DROUGHT WORKSHOPS

Contributors to the North American Drought Monitor (NADM) have increasingly recognized that global-scale drought monitoring, mitigation, and a response system would benefit all nations affected by drought, especially those in semiarid regions. In April 2010, NCDC scientists led three concurrent workshops aimed at identifying and addressing the unique needs of the international drought monitoring community. These workshops, held in Asheville, focused on better data sharing and information design. The result was improved bilateral drought monitoring arrangements between the United States and both Canada and Mexico, as well as a new vision for coordinating global drought monitoring efforts. The workshops also led to progress on creating drought early warning systems and regional drought monitoring centers in parts of many continents. All workshops noted the challenge of inadequate data and indices for detecting drought, which is a continuing area of international collaboration.

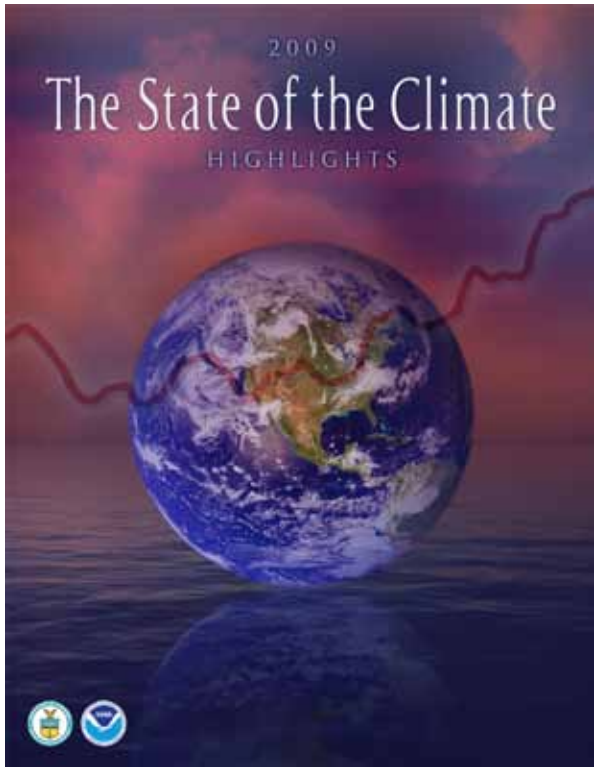


RELEASE OF THE 2009 *BULLETIN OF THE AMERICAN METEOROLOGICAL SOCIETY* STATE OF THE CLIMATE REPORT

For the 21st year, NOAA led the coordination, drafting, and communication of the 2009 State of the Climate Report, published in July 2010 in the *Bulletin of the American Meteorological Society*. The State of the Climate Report documents the status of the climate system and the capacity to observe it. This assessment is based upon observed conditions in more than 30 aspects of the climate system. More than 300 authors from 48 countries contributed to the 2009 edition. NCDC scientists and graphics professionals led the editorial construction and composition of the 220-page report. This year, NCDC also led the development of a summary document that distilled the scientific findings into an easy-to-interpret format and coordinated a high-level press effort in partnership with the United Kingdom Meteorological Office. The combination of the annual report, the media efforts, the companion document, and editorial decisions underscored the significance of the changing state of the Earth's climate. Eleven climate indicators, ranging from sea level to tropospheric temperature, were brought together to show the broad scope of evidence that the planet is indeed warming. All eleven climate indicators are moving in the direction one would expect in a warming climate.



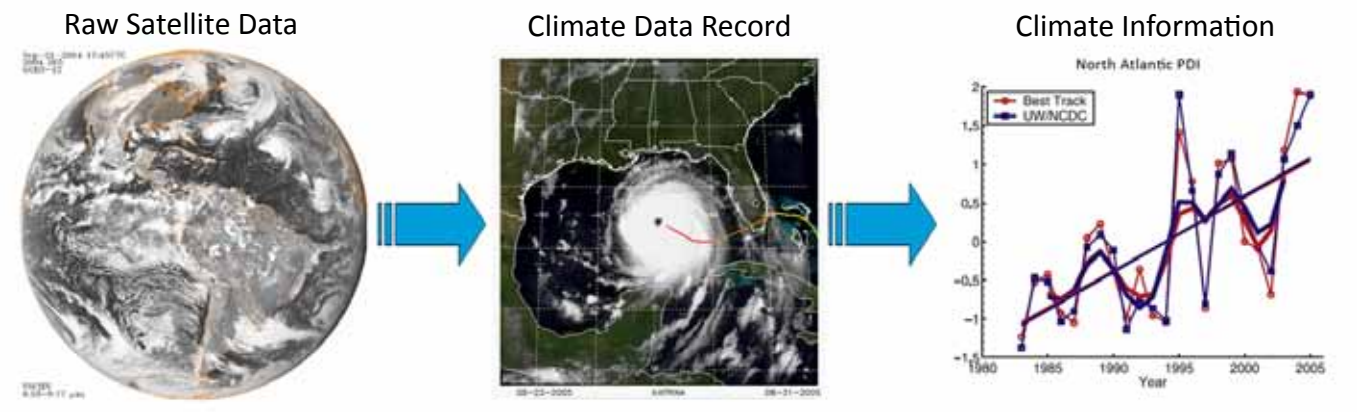
Seven of these indicators would be expected to increase in a warming world and observations show that they are, in fact, increasing. Four would be expected to decrease and they are, in fact, decreasing.



PIONEERING WORK SETS NEW STANDARD FOR ARCHIVE AND STEWARDSHIP OF CLIMATE INFORMATION

In 2010, scientists at NCDC began a pioneering program for the development of operational, long-term Climate Data Records (CDRs) from historical NOAA satellite data. Until now, there were multiple NOAA satellites with the same instruments, but no routine way to reliably compare long-term records from instrument to instrument to discern climate signals. Before the project's effort, this activity that allows satellite-to-satellite comparisons was limited to research laboratories and did not exist in an operational production environment. Therefore, NOAA's billions of dollars of investment in weather satellites were not being used operationally to monitor long-term climate measurements, nor were CDRs effectively reaching industry and other agencies that can fully capitalize on their value. NCDC scientists used peer-reviewed scientific algorithms to ensure that the targeted essential climate variables from each satellite instrument were being retrieved reliably and consistently. The group used research code and data and transformed them, through rigorous processes, into operational products that are safely archived, fully documented, openly accessible, and demonstrably reproducible. The program has provided unprecedented transparency by providing all the accompanying documentation, code, and descriptions necessary to fully understand and reproduce this climate data record to the public and other scientists.

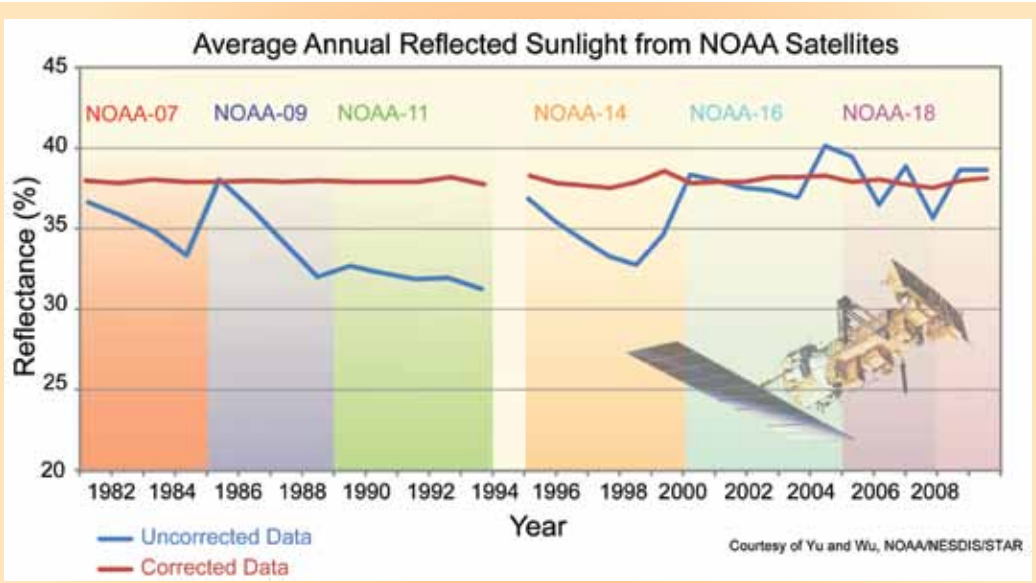
A Climate Data Record (CDR) is a unified and coherent collection of data, typically derived from many satellites spanning several decades. CDRs accurately characterize climate variability and change over the Earth's atmosphere, land, oceans, and ice sheets.



The Climate Data Record process uses raw satellite data to derive climate information. In this example, GOES data are used to derive hurricane tracks and this information has been used to show the increase in hurricane activity.

DELIVERY OF THREE OPERATIONAL CLIMATE DATA RECORDS

In 2010, NCDC transitioned its first three satellite-derived Climate Data Records (CDRs) from research to operationally produced and sustained climate records. The CDRs provide objective climate information derived from weather satellite data that NOAA has collected over the past 30 plus years. Satellite-based climate measurements represent the longest measurement on record with global reach and reflect a national investment of billions of dollars. For the first time, NOAA is operationally applying improved satellite analysis methods to this historical satellite data. CDRs reveal the global climate trends and variability information in the satellite measurements, thereby providing increased value from this national investment. In parallel, NCDC will extend these records by applying the same methods to present-day and future satellite measurements. The results will provide trustworthy and consistent information on how, where, and to what extent the land, oceans, atmosphere, and ice sheets are changing. The three CDRs delivered in FY 2010 include global calibrated records of Earth-reflected solar radiation, Earth-emitted infrared (thermal) energy, and water vapor in the upper troposphere as measured from NOAA's Polar Operational Environmental Satellite (POES) and Geostationary Operational Environmental Satellite (GOES) programs. NCDC's commitment to advancing CDR development is further leveraged by its sponsorship of over twenty external grants to continue development of new operational CDRs, including five new ones in FY 2011.

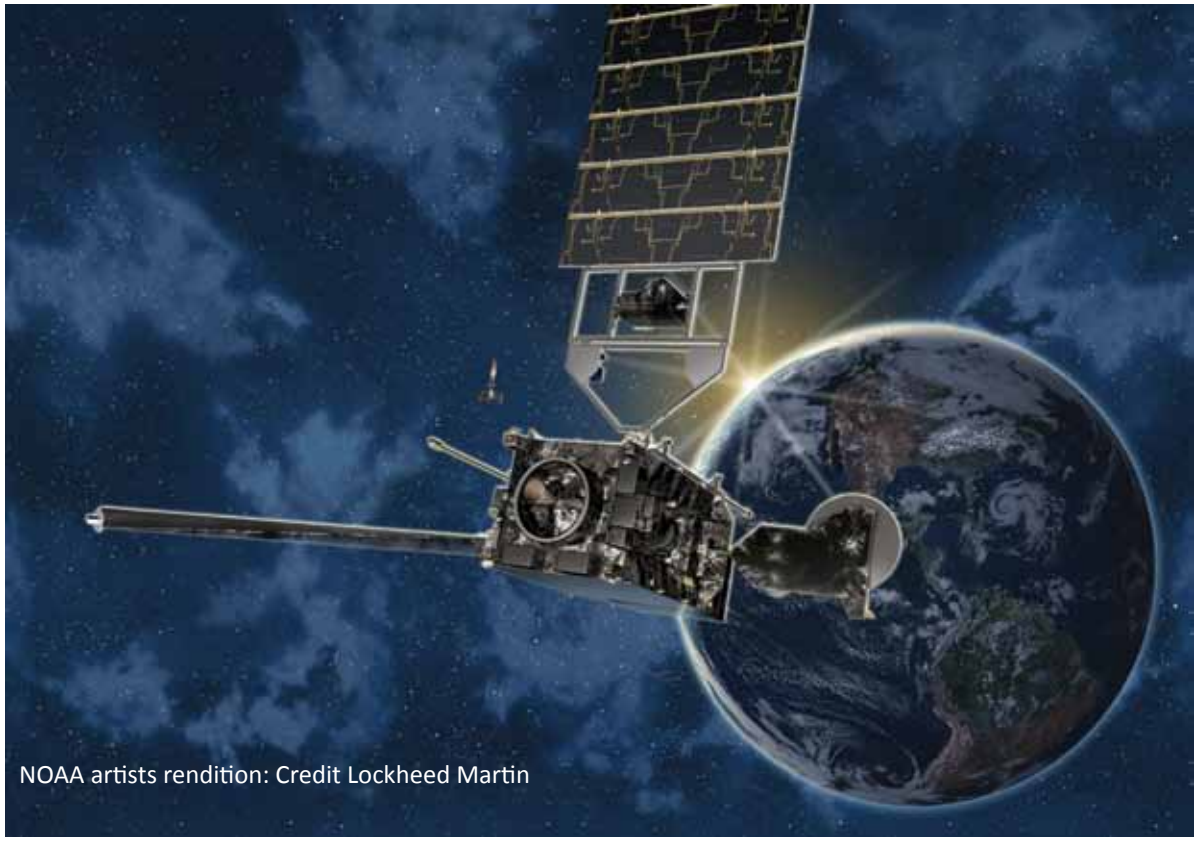


Uncorrected versus corrected reflected sunlight satellite measurements.

Who will benefit from CDRs?

A wide variety of groups and individuals, such as those from the health, energy, transportation, water resources, agriculture, and coastal communities, will be able to use information derived from CDRs to make well-informed strategic decisions in the face of a changing climate. This will help improve the nation's resilience to climate variability and change, maintain our economic vitality, and effectively plan for the future.

DEVELOPMENT OF NEXT-GENERATION SATELLITE ARCHIVE AND ACCESS REQUIREMENTS


NOAA artists rendition: Credit Lockheed Martin

NCDC and other NOAA data centers, working with the Geostationary Operational Environmental Satellite-R (GOES-R) program, completed archive and access requirements that make GOES-R the first new major observing system acquisition to comply with[1] the new NOAA Administrative Order (NAO) on management of environmental and geospatial data and information. Long-term digital information preservation is challenging, as data can only be useful when the information they represent is independently understandable by future users of these data. Preservation description information, as gathered in the archive and access requirements, is essential to ensure that future generations benefit from NOAA's multibillion dollar investment in Earth observations. The NAO captures NOAA's policy for the end-to-end stewardship needs for major observing systems, while also adhering to federal geospatial information policies, required records management regulations, and community practices as coordinated through interactions with the National Archives and Records Administration (NARA) and the Library of Congress. The NOAA policy on 'Procedure for Scientific Records Appraisal and Archive Approval' was identified by NARA as an industry best practice and is being considered as a template for several other agencies and universities.

[1] NOAA Administrative Order 212-15, "Management of Environmental Data and Information", (issued 08/22/91; effective 11/04/10).

GROWTH OF CLIMATE REFERENCE NETWORK STATIONS IN ALASKA

U.S. Climate Reference Network station at Sand Point, Alaska.

NCDC established the Climate Reference Network program in 2000 to create a sustainable, high-quality climate observation network that will be able to answer critical questions about how the climate of our Nation is changing with the highest degree of scientific confidence. In 2010, following a year-long evaluation and data quality test period, NCDC formally commissioned the first two U.S. Climate Reference Network (USCRN) stations in Alaska at Sand Point and Port Alsworth. These stations represent the first of 29 planned USCRN stations covering this expansive and ecologically diverse state. NCDC began the evaluation and data quality testing at two new USCRN sites at Red Dog Mine and Kenai, which are slated for commissioning in 2011. The site survey process continued in the summer of 2010 in preparation for up to six additional USCRN installations in 2011. Some of the most rapid changes in climate are occurring in high-latitude areas of the Northern Hemisphere, and this is especially evident in Alaska. The deployment of these CRN stations will greatly enhance NOAA's ability to monitor the changing climate of Alaska, to better understand the pace and character of climate change in the state, and improve the Nation's ability to plan for and respond to these changes. It will also help scientists better understand how high-latitude areas of the world in general respond to increases in greenhouse gases.

U.S. Climate Reference Network site at Red Dog Mine, Alaska.

INSTALLATION OF U.S. CLIMATE REFERENCE NETWORK SOIL MOISTURE AND SOIL TEMPERATURE SENSORS

As of September 2010, a total of 80 out of 114 USCRN stations in the contiguous United States have been outfitted with soil moisture and soil temperature sensors—important indicators of drought conditions and potential. Drought affects more people than any other natural hazard, and it is one of the most costly, with direct losses in the United States that average between $6 and $8 billion each year. As global surface temperatures rise in response to increasing greenhouse gases, there is evidence of an increase in the severity and frequency of drought. In collaboration with the National Integrated Drought Information System, the deployment of these sensors in the Nation's Climate Reference Network will aid in the scientific understanding of the changing nature of drought in the United States and will support efforts to plan for, respond to, and mitigate drought across the Nation. After a period of calibration of the data, soil data from these sites will be posted on the USCRN Web page and are available to the public. The remaining U.S. sites will be outfitted with soil sensors in 2011. This network of soil moisture and temperature sensors will provide scientists and decision makers with information to support climate change assessments and to aid in our Nation's ability to better monitor, plan for, and respond to drought events as they develop.

Installation at Fort Peck, Montana, August 31, 2006.

Dr. John Bates, Division Chief, Remote Sensing and Application Division

CLIMATE DATA AND INTERNATIONAL SATELLITE COMMUNITY

NCDC's Dr. John Bates represented NOAA as the climate lead at several international organizations. As an Executive Panel member of the Sustained, Coordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM), a collaboration between the Organization for the Exploitation of Meteorological Satellites and the World Meteorological Organization, Dr. Bates helped establish a framework for the objective assessment of climate products through an evaluation of these products' maturity in the scientific and user communities. Additionally, as the only NOAA representative at the initial meetings by the Committee on Earth Observation Satellites (CEOS) to form a Climate Working Group, Dr. Bates helped develop terms of reference for the proposed group. Approved in November 2010 at the CEOS annual meeting, the new working group will facilitate coordination and collaboration amongst research and operational space agencies and address the call to coordinate production and assessment of essential climate variables.

CONVERSION OF COOP NETWORK OBSERVATION FROM PAPER RECORDS TO DIGITAL ENTRY

The Cooperative Observer Program (COOP) consists of more than 7,500 stations where volunteer observers typically record daily weather observations on paper forms. These data are received at NCDC up to 45 days after the observations are taken, following mail submission and off-site digital keying of the data. In 2010, NOAA and the Regional Climate Center Program partnered to develop a Web-based data entry and quality control system for COOP observations called WxCoder III. This interface system reduces observation network and data management expenses, removes the need for paper forms, and provides higher quality climate data in near-real time. NOAA can now inject this valuable data into climate monitoring and analysis activities within 24 hours of observation. By the end of 2010, NOAA had converted nearly 50% of the COOP network to WxCoder III. Receiving the dense network of surface data in near-real time provides higher quality data for climate monitoring, forecast warnings and verification, model initialization, and other public service programs. At NCDC, the data provide a reliable resource for climate monitoring and assessment of extremes up to 50 days earlier than previously used. This approach is being rapidly expanded with the goal of eliminating paper submissions entirely in the near future.

Cooperative observer network observation station. Top left: precipitation recording gauge; top right: instrument shelter for recording maximum and minimum air temperature; bottom left: evaporation pan; bottom right; an observation station. With a few exceptions, the instruments used by cooperative observers have not changed significantly over the past century.

VISUALIZATIONS OF LONG-TERM MONSOON REGION DROUGHT

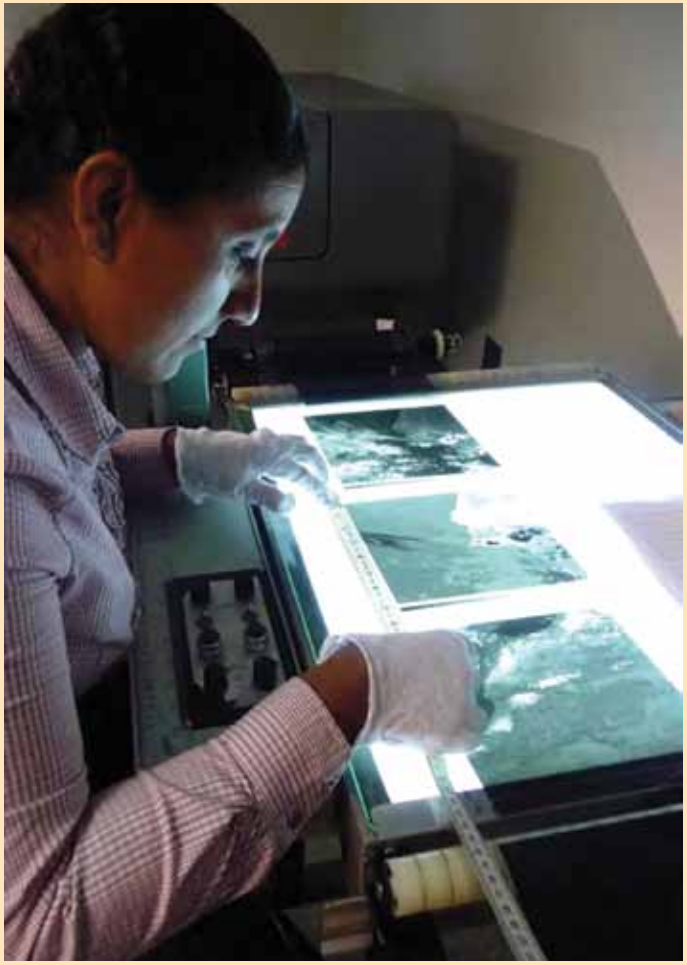
NCDC-built visualization tools that allow climate scientists and hydrologists to examine eastern and southern Asia drought patterns over the past 700-plus years in the newly released Monsoon Asia Drought Atlas (MADA) archived by NCDC. NCDC also built a Web-based, interactive portal to allow users to easily utilize the visualizations.

Boats on a river in Kerala, South India, during the rainy season.

The visualization tools reveal spatially-comprehensive drought patterns that could only be previously guessed at from sparse and incomplete historical information, despite the region being under the influence of the single large-scale circulation pattern commonly called the "monsoon." Better understanding drought in a region with nearly half of the world's population is particularly important for predicting hydrological changes in the region and also opens new possibilities for understanding the global drivers of hydrological dynamics. In addition, water managers can use the information to evaluate past droughts that are more extreme and/or longer than those experienced in the instrumental record, thus aiding long-term water system planning.

NCDC CONTINUES DATA RESCUE PROJECTS ACROSS NOAA

The Climate Data Modernization Program (CDMP) supports NOAA's responsibility to collect, integrate, assimilate, and effectively manage Earth observations on a global scale, ranging from atmospheric, weather, and climate observations to oceanic, coastal, and marine life observations.



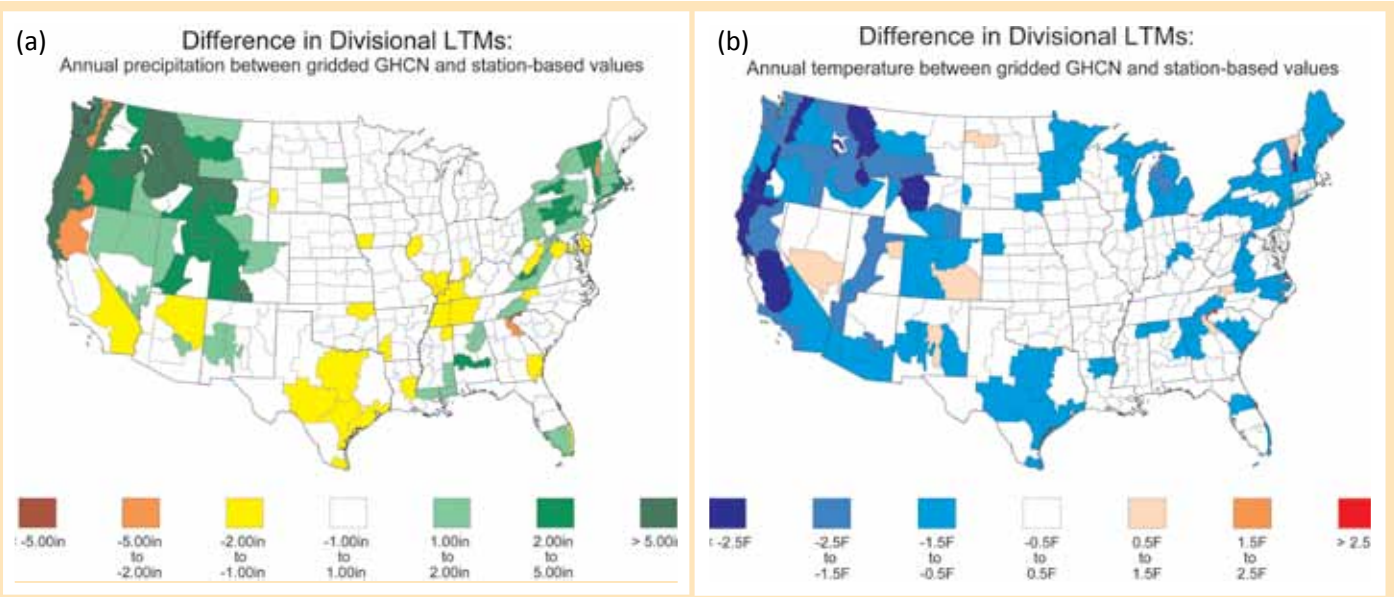
Special care is provided to these fragile film negatives by a CDMP contractor. CDMP has scanned over 57 million images in its eleven-year history.

Many of these data were originally recorded on paper, film, and other fragile media. Prior to CDMP, not only were these valuable data sources mostly unavailable to the scientific community, but storage technology for the archive had become obsolete. In 2010, NOAA's Climate Data Modernization Program managed 97 separate data rescue projects across NOAA. Many of these are multiyear tasks, and the data rescued contribute to the Nation's need for additional valuable scientific data to address climate and environmental challenges. Today, CDMP has greatly improved the preservation of and access to NOAA's holdings by migrating many of these resources to new digital media. CDMP has placed online over 54 million weather and environmental images that are now available to researchers around the world via the Internet. The amount of data put online has grown from 1.75 terabytes in 2001 to over 14 terabytes in 2010. Hourly weather records digitized through CDMP continue to be integrated into NOAA's digital database holdings. For example, CDMP digitized historical surface weather observations which extended the available online data records back to the eighteenth century for several stations. One 2010 project included keying surface weather observations from various "Navajo Nation" stations in the southwestern United States. Another one preserved old aerial photography images of the U.S. coastlines back to the 1920s.

The Climate Database Modernization Program (CDMP) mission is to make major climate and environmental databases available via the World Wide Web.

IMPROVED CLIMATE DIVISION DATABASE FOR THE CONTIGUOUS UNITED STATES

NCDC created an improved climate division database for use in operational climate monitoring and applied climatological research. As with its predecessor, the new database consists of 344 climate divisions, which cover the entire contiguous United States with a period of record for monthly temperature and precipitation averages from 1895 to present. The new version now provides robust estimates of area averages and long-term trends. Having improved climate division information provides users more specific local-area information about climate trends. NCDC used an improved underlying network, including additional station records and contemporary bias adjustments, and improved the computational methodology to address topographic and network variability via climatologically-aided interpolation. The improved database was critical because the dataset has widespread application in climatological research and is used extensively in NCDC State of the Climate Reports and in the U.S. Drought Monitor. An improved divisional database translates into higher-quality research applications and more accurate climate monitoring reports.



Difference in long-term means (LTMs) between the Gridded GHCN-D (GrDD) and traditional methods of determining climate division (a) precipitation (inches), and (b) temperature (degrees Fahrenheit). Mountainous climate divisions in the West tend to show cooler and wetter LTMs in the GrDD method. GHCN-D closely follows the traditional divisional dataset east of the Rockies.

DIGITIZING OF HISTORICAL HOURLY SURFACE AIRWAYS OBSERVATIONS EXTENDS ARCHIVAL PERIOD OF RECORD AN ADDITIONAL TWO DECADES

In 2010, NOAA's Climate Database Modernization Program (CDMP) began a multiyear project to image and digitize historical hourly airport-based surface airways observations. Performed in conjunction with the Northeast Regional Climate Center (NRCC), rescuing this data extends the archival period of record for hourly meteorological data from 1948 back into the late 1920s, when many airports began taking these observations, with some additional airport-related periodic observations back to the 1890s, . This major update is a milestone in NCDC's data recovery effort and provides the first serial complete data for several hundred U.S. stations from the 1890s to the present. To accomplish this task, CDMP scanned and made accessible over 40 million original paper observational forms, containing about 410 million weather observations, archived at NCDC. Climatologists, meteorologists, and many other scientists in related fields will be able to use these additional rescued observations to improve our understanding of the climate and weather patterns during that time period.

1863 weather log from Clark County, KY

Some rescued forms date from the late 18th century.

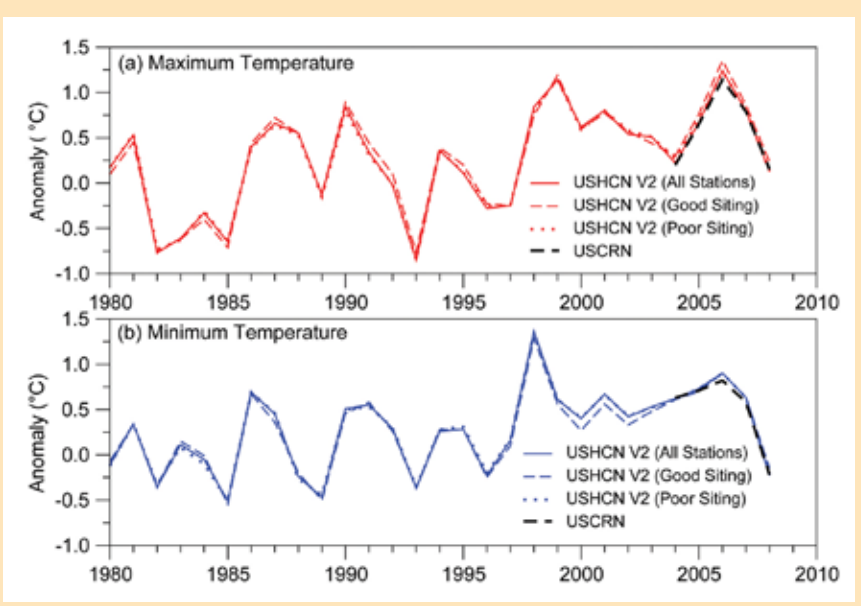
ASSURING THE RELIABILITY OF THE U.S. SURFACE TEMPERATURE RECORD

In January 2010, the paper entitled "On the Reliability of the U.S. Surface Temperature Record" was published in the peer-reviewed *Journal of Geophysical Research—Atmospheres*. Conducted by NCDC scientists Dr. Matthew Menne, Claude Williams, and Dr. Michael Palecki, this important study addressed the impact of poor siting conditions at stations in the U.S. Historical Climatology Network (USHCN) Cooperative Observation (COOP) network. NCDC needed to assess if and how the site conditions, such as locations next to buildings or heat sources, impacted the long-term temperature record. Through their study, Menne, Williams, and Palecki found that the continental U.S. temperature trends are not inflated due to poor exposure. Results indicated that there is a mean bias associated with poor exposure sites relative to good exposure sites; however, this bias is consistent with previously documented changes associated with the widespread conversion to electronic sensors in the USHCN COOP during the last 25 years. Homogeneity adjustments applied to USHCN Version 2 data were found to account for the impact of instrument and siting changes. The adjusted USHCN COOP temperatures were also found to be extremely well-aligned with measurements from the U.S. Climate Reference Network, whose instruments and exposure characteristics meet the highest standards for climate monitoring. This work verifies the validity of analyses included in the 2009 *Global Climate Change Impacts in the United States* report. It also shows that problems with station siting at USHCN COOP sites have been accurately addressed through application of the Menne and Williams Pairwise Homogeneity Adjustment algorithm and assures the integrity of the U.S. surface temperature record.

Dr. Matthew Menne

Claude Williams

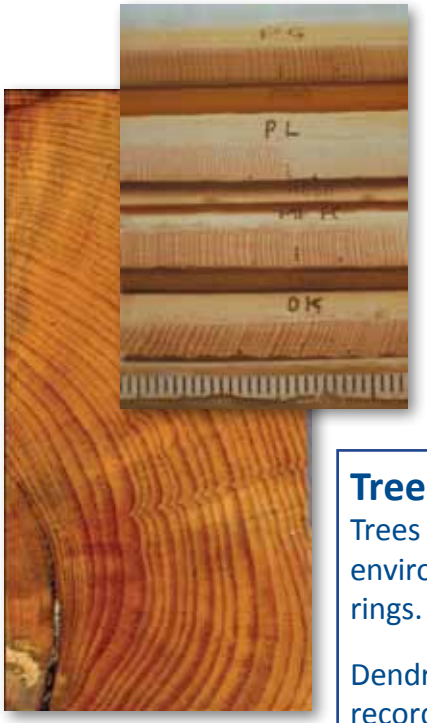
Dr. Michael Palecki



Comparison of the conterminous U.S. average annual (a) maximum and (b) minimum temperatures calculated using USHCN version 2 adjusted temperatures [Menne et al., 2009] and USCRN departures from the 1971–2000 normal. Good and poor site ratings are based on surfacestations.org.

DROUGHT RECORDS IN ASIA EXTENDED FARTHER BACK IN TIME USING TREE RING RECORDS

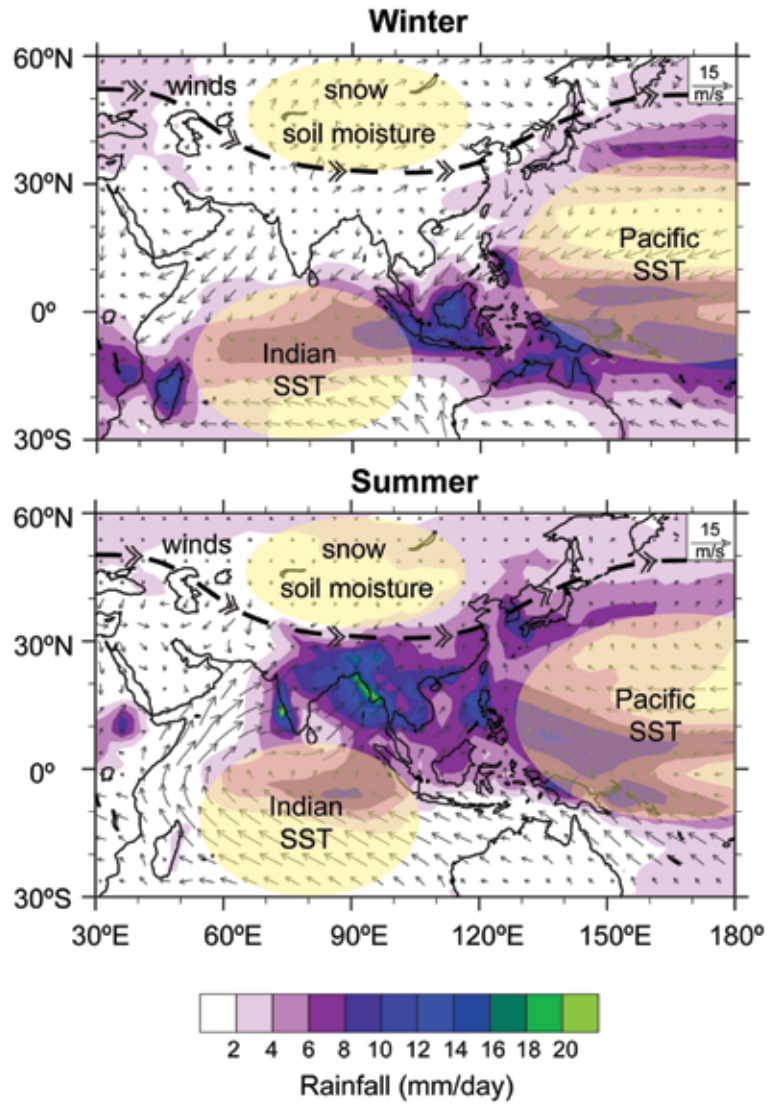
Natural variability in monsoon rainfall, including droughts and persistent heavy rainfall called "pluvials," affects billions of people and entire economies across Asia. Tree ring data provides a much longer history of drought variations bringing into sharper focus the decadal variability and revealing such extreme anomalies as "megadroughts," or droughts of longer duration that were more severe than anything observed in the short instrumental record. Long climate records that resolve the natural variability are essential to improved prediction of the Asian summer monsoon. NCDC archived the Monsoon Area Drought Atlas (MADA) data and provides maps, visualizations, and data of droughts that occurred centuries ago. Via MADA, NCDC provides a gridded reconstruction of the Palmer Drought Severity Index, derived from 327 tree ring chronologies and extending back to 1300 C.E. In addition to providing data files, NCDC also provides maps and interactive visualizations of major droughts and pluvials across monsoon Asia, such as the Ming Dynasty Drought (1638–1641) and The East India Drought (1790, 1792–1796).



Tree Rings:

Trees record information about past environments and climate in their annual growth rings.

Dendroclimatologists study tree rings to gather records of past temperature and drought.



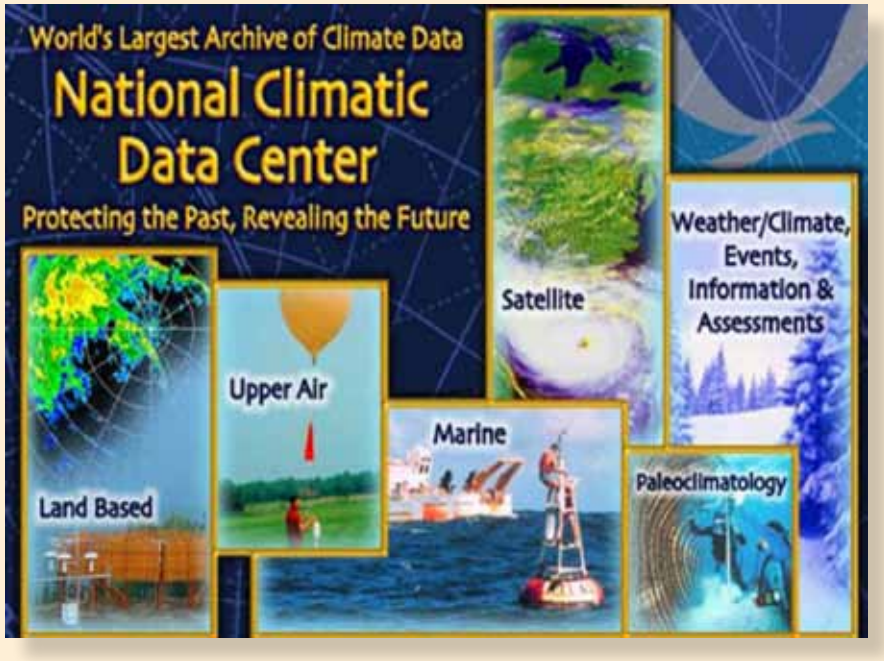
The Monsoon Asia Drought Atlas archived by NCDC maps past severe droughts and floods based on tree ring data extending back to 1300 C.E. This rich dataset demonstrates the importance of sea surface temperatures, winds, and land surface wetness for predicting winter and summer rainfall patterns.

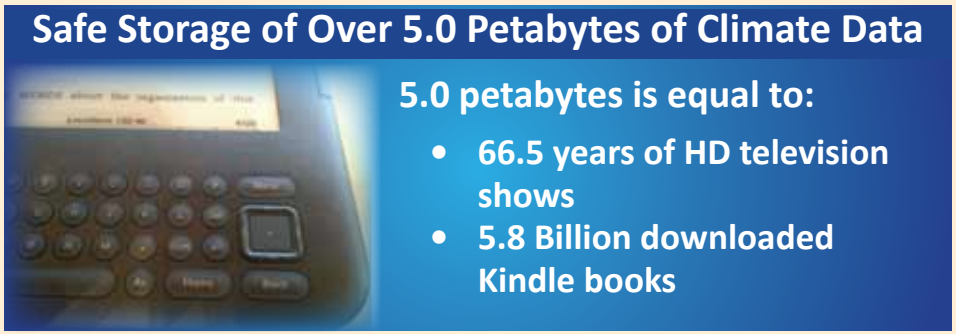
LEADERSHIP FOR THE USE OF NOAA'S ENTERPRISE ARCHIVE STORAGE SYSTEM

NCDC assumed a larger leadership role fin the NOAA Comprehensive Large-Array-data Stewardship System (CLASS) in 2010. The CLASS Operations and Planning Board reviewed the CLASS program and mapped out the future directions for the system to meet NOAA's operational archive needs. CLASS is the future of archive storage for all NOAA data, especially key future satellite systems and climate model data. NCDC led the day-to-day management of the operational CLASS system with other Data Center personnel, and has worked with the Data Centers and CLASS developers to prepare the system for future deliveries of NOAA's many data products.

RECORD-SETTING YEAR FOR ONLINE DATA ACCESS

NCDC provides a wealth of scientific data online in a variety of formats for quick and convenient access. These data and products serve to support decision making for a wide variety of users across public, private, and academic interests. During 2010, NCDC delivered 1,260 terabytes of data online via Web systems and services, compared to 675 terabytes in 2009, representing a 87% increase. This continues the sharp trend of growth seen over the past decade in data access via NCDC's Web resources, and also reflects enhancements made to allow customers to download much larger volumes of model, radar, and satellite data. Over 2.5 petabytes of data are now accessible from NCDC's Web site. This data growth maintains the rapid increase in the in situ, NEXRAD, satellite, and model data available online via NCDC's services. To keep up with increasing data demand, NCDC continues to implement hardware upgrades able to manage the rapidly increasing system load and vast online data resources.





SUPPORTING FEDERAL CLIMATE ASSESSMENT SERVICES

NOAA established a Technical Support Unit (TSU) at NCDC to provide critical information and capabilities to support the National Climate Assessment (NCA), being run by the U.S. Global Change Research Program (USGCRP). The National Climate Assessment is being conducted under the auspices of the Global Change Research Act of 1990, which requires a report to the President and Congress that evaluates, integrates, and interprets the findings of the federal research program on global change (USGCRP) every four years. With the next Assessment due in 2013, the agencies comprising the U.S. Global Change Research Program seek not only to deliver the assessment report, but also to establish an ongoing, sustainable assessment process, which will require a wide network of interagency and external support. A key component of this ongoing process will be an interactive Web presence for NCA. The NCA aims to incorporate advances in the understanding of climate science into larger social, ecological, and policy system understanding and with this, provide integrated analyses of impacts and vulnerability. The NCA will help evaluate the effectiveness of mitigation and adaptation activities in the face of a changing climate. Further information can be found at:
http://globalchange.gov/what-we-do/assessment.

National Climate Assessment
U.S. Global Change Research Program

IMPROVING HURRICANE FORECASTS IN THE ATLANTIC

NOAA's National Hurricane Center Atlantic hurricane forecasts include information on track and storm intensity. Over the past twenty years, errors in track have been cut in half, but intensity forecasting is still a key research area. Dr. Jim Kossin of NCDC contributed to improving intensity forecasts with the development of two experimental models: one for predicting hurricane eyewall replacement cycles (ERC), and one aimed at understanding rapid intensity changes. In 2010, the ERC model became fully operational during hurricane season and has the potential to improve not only forecasts but also storm surge predictions. Both projects are part of the Joint Hurricane Testbed research-to-operations project.

Dr. Jim Kossin

NCDC BEGINS NEW REGIONAL CLIMATE SERVICE PROGRAM WITH SIX REGIONAL CLIMATE SERVICE DIRECTORS

On September 14, 2010, Commerce Secretary Gary Locke announced the selection of six new NOAA Regional Climate Service Directors (RCSDs) to assist NOAA in its effort to more effectively meet the rising public and private demand for climate products and services. Co-located with the National Weather Service regional offices, the new directors will work to build and strengthen regional partnerships to better assess and deliver regionally-focused climate science and information products and services to help people make informed decisions in their lives, businesses, and communities.

The new directors are:

Ellen Mecray, Eastern Region, Bohemia, New York;
Doug Kluck, Central Region, Kansas City, Missouri;
David Brown, Southern Region, Fort Worth, Texas;
DeWayne Cecil, Western Region, Salt Lake City, Utah;
John Marra, Pacific Region, Honolulu, Hawaii; and
James Partain, Alaska Region, Anchorage, Alaska.

Ellen Mecray

Doug Kluck

David Brown

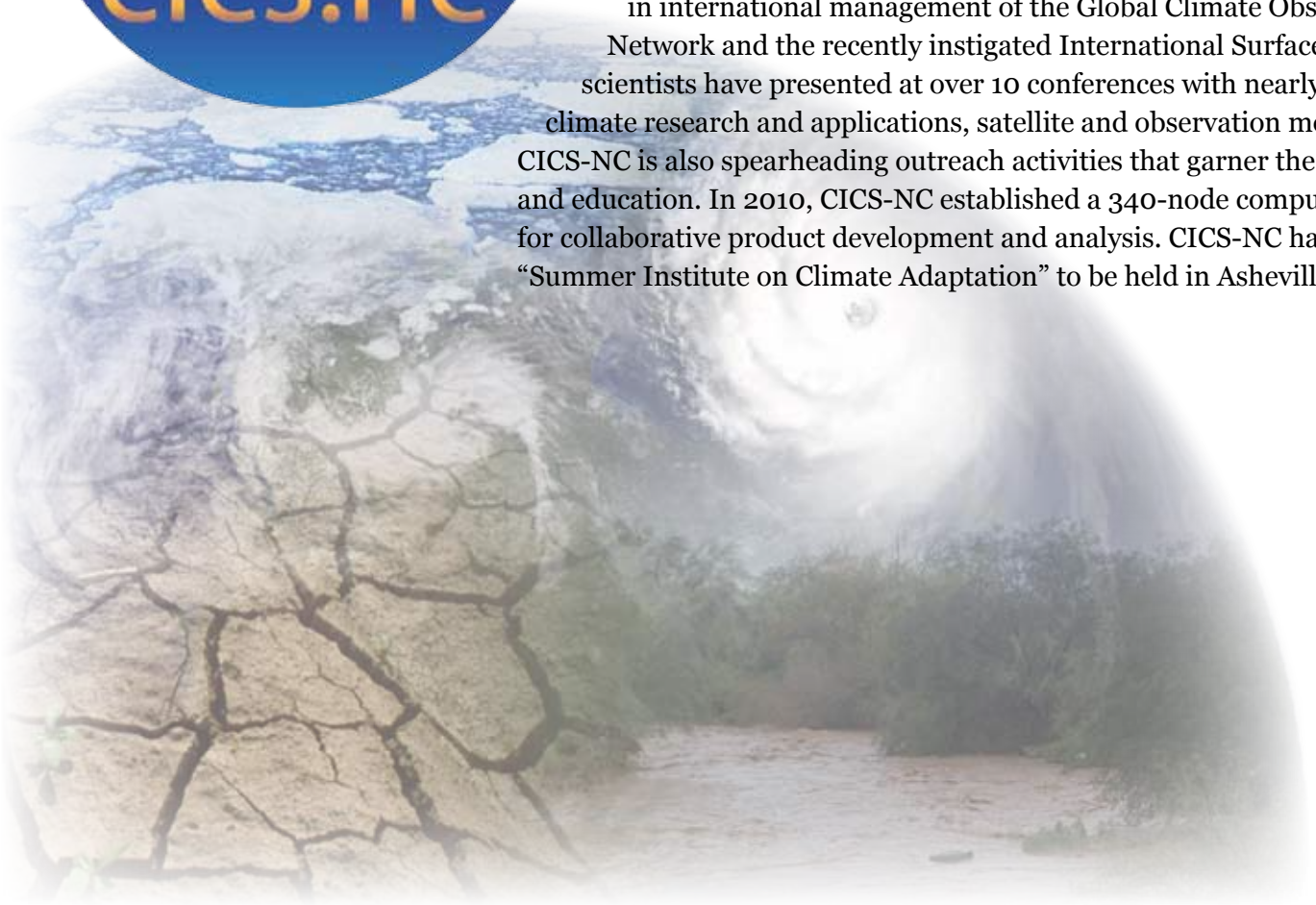
DeWayne Cecil

John Marra

James Partain

CONTINUED GROWTH OF COOPERATIVE INSTITUTE FOR CLIMATE AND SATELLITES NORTH CAROLINA (CICS-NC)

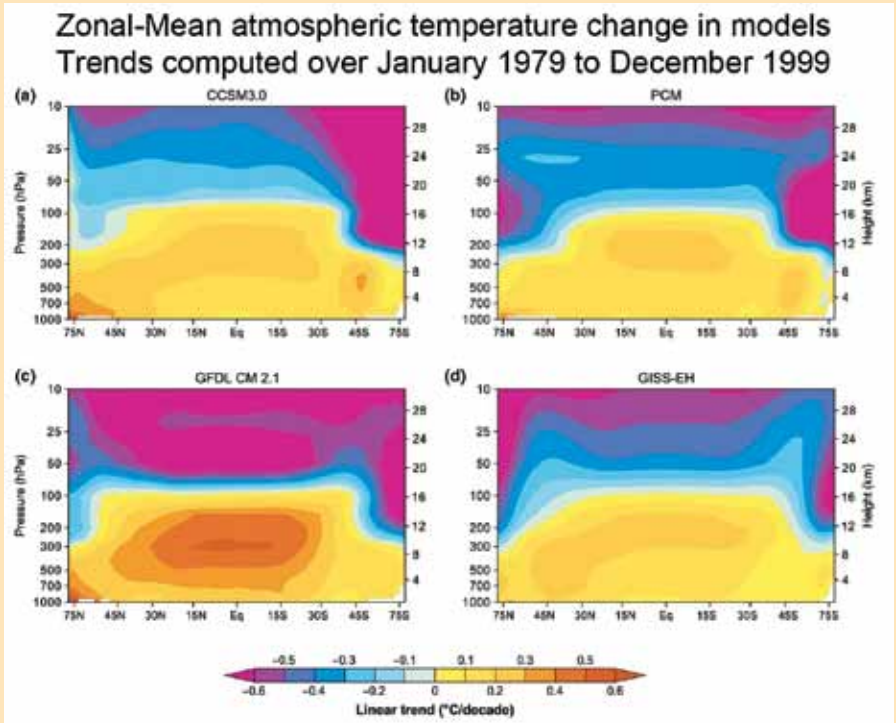
Since the inauguration of CICS-NC on July 1, 2009, the CICS-NC team has grown to 20 researchers (14 PhD and 6 MA/MS) supporting the NCDC mission with a focus on enhancing the collective interdisciplinary understanding of the state and evolution of the full Earth system. Focusing on seven research areas, from Climate Data Records to National/Regional Assessments, these researchers published nearly 20 peer-reviewed papers since its inception. Over the past year, CICS-NC scientists led contributions to the IPCC Fifth Assessment Report, edited a chapter of the authoritative 2009 State of the Climate annual report, and engaged in international management of the Global Climate Observing System Reference Observing Network and the recently instigated International Surface Temperature Initiative. CICS-NC scientists have presented at over 10 conferences with nearly 20 presentations on the topics of climate research and applications, satellite and observation monitoring, and climate modeling. CICS-NC is also spearheading outreach activities that garner the value of science, innovation, research, and education. In 2010, CICS-NC established a 340-node computing cluster used by researchers for collaborative product development and analysis. CICS-NC has also initiated the planning for the "Summer Institute on Climate Adaptation" to be held in Asheville in June 2012.



The profound implications of climate change underscore that scientists and decision makers together must develop proactive measures and evaluate options for adaptation.

TROPOSPHERIC TEMPERATURE TRENDS

Scientists at NOAA, the NOAA-funded Cooperative Institute for Climate and Satellites (CICS), the United Kingdom Meteorological Office, and the University of Reading in the United Kingdom contributed to the paper, "Tropospheric Temperature Trends: History of an Ongoing Controversy," a review of four decades of data and scientific papers. The paper was published in November 2010 by *Wiley Interdisciplinary Reviews: Climate Change*, a peer-reviewed journal. According to this extensive literature review, the science conclusively states that the troposphere, the lower part of the atmosphere closest to the Earth, is warming and that this warming is broadly consistent with both theoretical expectations and climate models. In the 1990s, some observations did not show the troposphere, particularly in the tropics, to be warming even though surface temperatures were rapidly warming. This lack of tropospheric warming was used by some to question both the reality of the surface warming trend and the reliability of climate models as tools. In extensively reviewing the relevant scientific analyses—195 cited papers, model results, and atmospheric datasets—the paper states that the body of science shows there is no longer evidence for a fundamental discrepancy and that the troposphere is indeed warming.



Simulated 1979–1999 temperature trends from four modern-day climate models with representations of human-induced and natural forcings. All exhibit a warming troposphere with a maximum in the tropical upper troposphere and a cooling stratosphere, but with differences in trend patterns and magnitudes. Adapted from Climate Change Science Program Synthesis and Assessment Product 1.1.2

HOSTING NOAA-WIDE CONTINUITY OF OPERATIONS EFFORT

In May 2010, NCDC served as the host for all of NOAA leadership and as the offsite location for a NOAA-wide continuity of operations (COOP) exercise during the 2010 government-wide COOP exercise called Eagle Horizon. As part of this event, NCDC turned itself into the "hub" of NOAA-wide operations, representing and coordinating all aspects of NOAA—from fisheries management to environmental satellite operations. During the exercise, NCDC staff offered use of /vacated their offices, established the NOAA Incident Command Center, and assisted with the role-playing exercise by representing various NOAA line offices.

NCDC Intern Program

In 2010, NCDC continued its tradition of hosting a robust summer intern program working with students interested in climate science from local universities, historically black colleges and universities (HBCUs), and other students through various NOAA-wide intern programs. The 2010 Intern class included:

- **Chip Helms**, University of North Carolina-Asheville (UNCA), who worked on Identifying Tropical Cloud Clusters in Satellite Imagery;
- **Renée Isaacs**, UNCA, who worked on Communications and Climate Monitoring;
- **Chauntè Lacewell**, North Carolina Agricultural and Technical State University (NC A&T), who worked on Using Satellites to Detect Tropical System Development;
- **Jacki Ritzman**, Valparaiso University, who worked on Inland Wind Studies of Tropical Cyclones;
- **Lisa Rizzo**, University of Colorado at Boulder, who worked on a Tropical Cyclone Inventory;
- **Kyle Sadelson**, UNCA, who worked on Value Correction and the Climate Data Base Modernization Program;
- **Clay Tabor**, UNCA, who worked on Developing Snow Indices;
- **Anna Trevino**, Louisiana State University, who worked on Climate Briefings and Climate Monitoring; and
- **William Wright**, NC A&T, who worked on Web Service Issues.

NCDC SCIENCE PUBLICATIONS AND POSTERS

Scientists at NCDC published over 40 papers in peer-reviewed journals such as *Bulletin of the American Meteorological Society*, *Journal of Applied Meteorology and Climatology*, *Geophysical Research Letters*, *Journal of Climate* and a host of others. They also gave almost 150 presentations or posters on NCDC climate science and applications at over 35 different conferences. Reaching out to both the traditional science conferences such as the American Geophysical Union and the American Meteorological Society as well as users of climate information at forums such as Southern Appalachian Man and the Biosphere Conference and the Association of American Geographers, NCDC scientists continue to provide groundbreaking climate science research and climate applications for the Nation.

2010 AWARDS TO NCDC STAFF

Department of Commerce Gold Medal

David Anderson, Jay Lawrimore, Thomas Peterson, Eileen Shea and Sara Veasey
For producing a major scientific report detailing the impacts of global climate change in the United States.

Department of Commerce Silver Medal*

Matthew Menne and Claude Williams
For major innovations in climate data preservation and providing the authoritative source of data for understanding the Nation's changing climate.

Howard Diamond, Ken Knapp, and David Levinson
For major innovations in climate stewardship, providing the authoritative source of historical hurricane track data to the global climate community.

*See photos on page 30.

2010 Distinguished Career Award

Dr. Peter Steurer

Peter Steurer
For sustained professional climate service to the Nation including customer service, product development, data stewardship, partnerships, and economic studies.

2010 NOAA Administrator's Award

Peter Steurer
For leading the development of a NOAA procedure that determines what scientific records to archive, a procedure that received best practice recognition by the National Archives Records Administration.

2010 Department of Commerce Bronze Medal Award

Dr. Huai-min Zhang

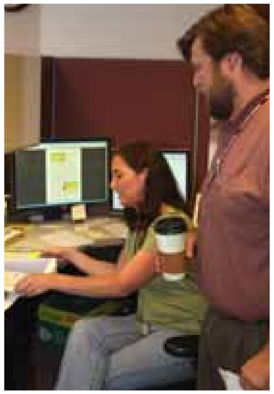
Huai-min Zhang
For the exemplary production, stewardship, and dissemination of global blended sea-surface wind products from satellite and computer model data.

THE PRESIDENTIAL EARLY CAREER AWARD FOR SCIENTIST AND ENGINEERS (PECASE)

In February 1996, the National Science and Technology Council (NSTC), was commissioned by President Clinton to create an award program that would honor and support the extraordinary achievements of young professionals at the outset of their independent research careers in the fields of science and technology. The Presidential Award embodies the high priority placed by the government on maintaining the leadership position of the United States in science by producing outstanding scientists and engineers who will broadly advance science and the missions important to the participating agencies.

The Presidential Early Career Award for Scientist and Engineers (PECASE) Department of Commerce breakfast. NCDC's Dr. Matthew Menne (center) received this award in May 2010.

TRIBUTE TO NCDC STAFF




















Peer-review papers:

Arguez, A., and R.S. Vose, 2010: The definition of the standard WMO climate normal: The key to driving alternative climate normals. *Bulletin of the American Meteorological Society*, Early online release, doi:10.1175/2010BAMS2955.1.

Brunet, M., J. Asin, J. Sigró, M. Bañón, F. García, E. Aguilar, J.E. Palenzuela, T.C. Peterson, and P. Jones, 2010: The minimization of the screen bias from ancient western Mediterranean air temperature records: An exploratory statistical analysis. *International Journal of Climatology*, Early view, doi:10.1002/joc.2192.

Cerveny, R.S., B.M. Svoma, and R.S. Vose, 2010: Lunar tidal influence on inland river streamflow across the conterminous United States. *Geophysical Research Letters*, **37**, L22406, doi:10.1029/2010GL045564.

Cook, E.R., R. Seager, R.R. Heim Jr., R.S. Vose, et al., 2010: Megadroughts in North America: Placing IPCC projections of hydroclimatic change in a long-term paleoclimate context. *Journal of Quaternary Science*, **25**, 48–61.

DeGaetano, A.T., T.J. Brown, S.D. Hilberg, K. Redmond, K. Robbins, P. Robinson, M. Shulski, and M. McGuirk, 2010: Towards regional climate services: The role of NOAA's Regional Climate Centers. *Bulletin of the American Meteorological Society*, **91**, 1633–1644.

Diamond, H.J., N. Plummer, and K. Walsh, 2010: Southern hemisphere meteorology and oceanography. *Bulletin of the American Meteorological Society*, **91**, 245–249.

Durre, I., M.J. Menne, B.E. Gleason, T.G. Houston, and R.S. Vose, 2010: Comprehensive automated quality assurance of daily surface observations. *Journal of Applied Meteorology and Climatology*, **49**, 1615–1633.

Justice, C.O., E. Vermote, J.L. Privette, and A. Sei, 2011: The evolution of U.S. moderate resolution optical land remote sensing from AVHRR to VIIRS. IN: *Land Remote Sensing and Global Environmental Change,* B. Ramachandran, C.O. Justice, and M.J. Abrams, Eds. Springer, pp. 781–806.

Knapp, K.R., and M.C. Kruk, 2010: Quantifying interagency differences in tropical cyclone best-track wind speed estimates. *Monthly Weather Review*, **138**, 1459–1473.

Knapp, K.R., M.C. Kruk, D.H. Levinson, H.J. Diamond, and C.J. Neumann, 2010: The International Best Track Archive for Climate Stewardship (IBTrACS) unifying tropical cyclone data. *Bulletin of the American Meteorological Society*, **91**, 363–376.

Kossin, J.P., S.J. Camargo, and M. Sitkowski, 2010: Climate modulation of North Atlantic hurricane tracks. *Journal of Climate*, **23**, 3057–3076.

Knutson, T.R., J.L. McBride, J. Chan, K. Emanuel, G. Holland, C. Landsea, I. Held, J.P. Kossin, A.K. Srivastava, and M. Sugi, 2010: Tropical cyclones and climate change. *Nature Geoscience*, **3**, 157–163.

Kruk, M.C., E.J. Gibney, D.H. Levinson, and M. Squires, 2010: A climatology of inland winds from tropical cyclones for the eastern United States. *Journal of Applied Meteorology and Climatology*, **49**, 1538–1547.

BIBLIOGRAPHY

Kruk, M.C., K.R. Knapp, and D.H. Levinson, 2010: A technique for combining global tropical cyclone best track data. *Journal of Atmospheric and Oceanic Technology*, **27**, 680–692.

Levinson, D., H. Diamond, K. Knapp, M. Kruk, and E. Gibney, 2010: Toward a homogeneous global tropical cyclone best track dataset. *Bulletin of the American Meteorological Society*, **91**, 377–380.

Levinson, D.H., P.J. Vickery, and D.T. Resio, 2010: A review of the climatological characteristics of gulf hurricanes for wind, wave, and surge hazard estimation. *Ocean Engineering*, **37**, 13–25.

Menne, M.J., C.N. Williams Jr., and M.A. Palecki, 2010: On the reliability of the U.S. surface temperature record. *Journal of Geophysical Research*, **115**, D11108, doi:10.1029/2009JD013094.

Nelson, B.R., D.-J. Seo, and D. Kim, 2010: Multi-sensor precipitation reanalysis. *Journal of Hydrometeorology,* **11**, 666–682.

Peterson, T.C., and O. Baddour, 2010: Towards an enhanced climate system monitoring: Challenges and perspectives. *Climate Research*, in press, doi:10.3354/cr00951.

Rahimzadeh, F., A. Noorian, M. Pedram, and M.C. Kruk, 2010: Wind speed variability over Iran and its impact on wind power potential: A case study for Esfehan Province. *Meteorological Applications,* Early view, doi:10.1002/met.229.

Rappaport, E.N., J.L. Franklin, A.B. Schumacher, M. DeMaria, L.K. Shay, and E.J. Gibney, 2010: Tropical cyclone intensity change before U.S. Gulf coast landfall. *Weather and Forecasting*, **25**, 1380–1396.

Rasmussen, M.O., A.C. Pinheiro, S.R. Proud, and I. Sandholt, 2010: Modeling angular dependences in land surface temperature from the SEVIRI instrument onboard the geostationary Meteosat second generation satellites. *IEEE Transactions on Geoscience and Remote Sensing*, **48**, 3123–3133.

Reynolds, R.W., and D.B. Chelton, 2010: Comparisons of daily sea surface temperature analyses for 2007-08. *Journal of Climate*, **23**, 3545–3562.

Reynolds, R.W., C.L. Gentemann, and G.K. Corlett, 2010: Evaluation of AATSR and TMI Satellite SST Data. *Journal of Climate*, **23**, 152–165.

Rutherford, S., M.E. Mann, C. Ammann, and E. Wahl, 2010: Comment on: "A surrogate ensemble study of climate reconstruction methods: Stochasticity and robustness" by Christiansen, Schmith and Thejll. *Journal of Climate*, **23**, 2832–2838.

Saha, S. S. Moorthi, H.L. Pan, … G.R. Rutledge, et al. 2010: The NCEP climate forecast system reanalysis. *Bulletin of the American Meteorological Society*, **91**, 1015–1057.

Semunegus, H., W. Berg, J.J. Bates, K.R. Knapp, and C. Kummerow, 2010: An extended and improved Special Sensor Microwave Imager (SSM/I) period of record. *Journal of Applied Meteorology and Climatology*, **49**, 424–436.

Stickler, A. A.N. Grant, T. Ewen, T.F. Ross, R.S. Vose, et al., 2010: The comprehensive historical upper-air network. *Bulletin of the American Meteorological Society*, **91**, 741–751.

Sun, F., M.D. Goldberg, X. Liu, and J.J. Bates, 2010: Estimation of outgoing longwave radiation from Atmospheric Infrared Sounder radiance measurements. *Journal of Geophysical Research*, **115**, D09103, doi:10.1029/2009JD012799.

Thorne, P.W., and R.S. Vose, 2010: Reanalyses suitable for characterizing long-term trends: Are they really achievable? *Bulletin of the American Meteorological Society*, **91**, 353–361.

Thorne, P.W., J.R. Lanzante, T.C. Peterson, D.J. Seidel, and K.P. Shine, 2010: Tropospheric temperature trends: History of an ongoing controversy. *WIREs Climate Change*, Early View, doi:10.1002/wcc.80.

Trouet, V., A.H. Taylor, E.R. Wahl, C.N. Skinner, and S.L. Stephens, 2010: Fire-climate interactions in the American West since 1400 CE. *Geophysical Research Letters*, **37**, L04702, doi:10.1029/2009GL041695.

Vila, D., R. Ferraro, and H. Semunegus, 2010: Improved global rainfall retrieval using the Special Sensor Microwave Imager (SSM/I). *Journal of Applied Meteorology and Climatology*, **49**, 1032–1043.

Wahl, E.R., D.M. Anderson, B.A. Bauer, R. Buckner, E.P. Gille, W.S. Gross, M. Hartman, and A. Shah, 2010: An archive of high-resolution temperature reconstructions over the past 2+ millennia. *Geochemistry Geophysics Geosystems*, **11**, Q01001, doi:10.1029/2009GC002817.

Wahl, E.R., and C. Morrill, 2010: Toward understanding and predicting monsoon patterns. *Science*, **328**, 437–438.

Wahl, E., C. Schoelzel, J. Williams, and S. Tigrek, 2010: Comment on 'The value of multiproxy reconstruction of past climate' by Li et al., The use and value of Bayesian hierarchical modelling for paleoclimate reconstruction: Including a new pollen-climate data model. *Journal of the American Statistical Association,* **105**, 900–905.

Wang, Y., A. Lyapustin, J. Privette, et al., 2010: Assessment of biases in MODIS surface reflectance due to Lambertian approximation. *Remote Sensing of the Environment*, **114**, 2791–2801.

Wilkinson, C., S. Woodruff, P. Brohan, S. Claesson, E. Freeman, et al., 2010: RECovery of Logbooks And International Marine Data: The RECLAIM Project. *International Journal of Climatology*, Early View, doi:10.1002/joc.2102.

Woodruff, S., S. Worley, S. Lubker, Z. Ji, E. Freeman, et al., 2010: ICOADS Release 2.5: Extensions and enhancements to the surface marine meteorological archive. *International Journal of Climatology*, Early View, doi:10.1002/joc.2103.

Yin, X.G., A. Gruber, 2010: Validation of the abrupt change in GPCP precipitation in the Congo River Basin. *International Journal of Climatology*, **30**, 110–119.

Zhao, T.X.-P., S. Ackerman, and W. Guo, 2010: Dust and smoke detection for multi-channel imagers. *Remote Sensing*, **2**, 2347–2368.

Peer-Reviewed Reports

Arndt, D.S., M.O. Baringer, and M.R. Johnson, Eds., 2010: State of the Climate in 2009. *Bulletin of the American Meteorological Society*, **91(7)**, S1–S224.

- Baringer, M.O., and D.S. Arndt: Introduction, pp. S14–S17.
- Diamond, H.J., Ed.: The tropics, pp. S79–S106.
- Fenimore, C., J. Crouch, R.R. Heim Jr., and J. Blunden: United States, pp. S137–S142.
- Gleason, K.L., and M.C. Kruk: South Indian Ocean (SIO), pp. S96–S97.
- Kennedy, J.J., P.W. Thorne, T.C. Peterson, R.A. Ruedy, P.A. Stott, D.E. Parker, S.A. Good, H.A. Titchner, and K.M. Willett: How do we know the world has warmed?, pp. S26–S27.
- Kruk, M.C., and K.L. Gleason: North Indian Ocean (NIO), pp. S95–S96.
- Levinson, D.H., E.J. Gibney, J. Weyman, and M.C. Kruk: Eastern North Pacific (ENP) basin, pp. S88–S91.
- Levinson, D.H., K.A. Hilburn, J.H. Lawrimore, and M.C. Kruk: Global precipitation, pp. S31–S32.
- Menne, M.J., and J.J. Kennedy: Global surface temperatures, pp. S24–S25.
- Xue, Y., R.W. Reynolds, and V. Banzon: Sea surface temperatures, pp. S53–56.

Conference presentations and publications

American Geophysical Union Fall Meeting, 13–17 December 2010, San Francisco, CA

Anderson, D.M.: Revised reconstruction of the glacial ocean deep sea carbonate ion concentration based on fossil foraminifer assemblages.
Ansari, S., S. Del Greco, and B. Hankins: The weather and climate toolkit.
Cao, C., R. Chen, W.P. Menzel, and L. Shi: Recalibration of historical HIRS level 1b data for climate studies.
Crouch, J., T.W. Wallis, and D. Arndt: A U.S. wind climatology: New tools to monitor wind trends across the contiguous United States.
Easterling, D.R.: An overview of the IPCC Special Report on Extremes.
Horsfall, F.M., D.R. Kluck, M. Brewer, M.M. Timofeyeva, J. Symonds, S. Dummer, M. Frazier, M. Shulski, and A. Akyuz: Devils Lake climate, weather, and water decision support system.
Levinson, D.H., and P.M. Scholz: NOAA's role in the monitoring and prediction of sea-level rise: Historical datasets and scientific gaps.
Magnusdottir, G., C. Bain, P. Smyth, H. Stern and K. Knapp: Variability and trends in area, location, cloudiness and cloud top temperature of the ITCA in the east to central Pacific over the past 30 years.
Morrill, C., R.W. Katz, and D. Atkinson: Patterns of abrupt ecosystem change through the Holocene.
Phillips, M.B.: Multigraph: Interactive data graphs on the web.

Phillips, M.B.: Multigraph: Reusable interactive data graphs.
Prat, O.P., B.R. Nelson, and T.M. Rickenbach: A multi-sensor approach to access precipitation patterns and hydro-climatic extremes in the southeastern United States.
Privette, J.L., J.J. Bates, and E.J. Kearns: Developing NOAA's climate data records from AVHRR and other data.
Rutledge, G.K., D. Williams, C. Deluca, S. Hankin, and G. Compo: Data integration plans for the NOAA National Climate Model Portal (NCMP).
Smith, A.B.: Examining insurance loss return periods with extreme event intensity thresholds across the US: 1980-2010.
Squires, M.F.: Development of a GIS snowstorm database.
Stroumentova, N., P.Ya. Groisman, R.W. Knight, and T.R. Karl: Changes in intense precipitation over the conterminous U.S.
Wagner, A.J., C. Morrill, B. Otto-Bliesner, and N. Rosenbloom: Comparison of 8.2 ka flood simulations: A model sensitivity experiment.
Wahl, E.R., and C. Schoelzel: A taxonomic reduced-space pollen model for paleoclimate reconstruction.

20th Southern Appalachian Man and the Biosphere (SAMAB) Conference: Climate Change: Science to Action, 16–18 November, 2010, Gatlinburg, TN
Houston,T.G.: NOAA climate services: Sectoral engagement activities at NOAA's National Climatic Data Center.

Sixth Annual Symposium on Future National Operational Environmental Satellite Systems-NPOESS and GOES-R, 17–21 January 2010, Atlanta, GA (AMS)
Bates, J., J. Privette, and D. Saunders: Sustained coordinate processing of essential climate variables at the national and international levels.
Kopp, T.J., R. Arnone, K.D. Hutchison, J.M. Jackson, H. Kilcoyne, M. Plonski, J.L. Privette, et al.: NPOESS preparatory project validation program for the visible/infrared imager/radiometer suite.
Privette, J.L., C. Justice, P. Romanov, E. Vermote, et al.: Validating VIIRS land and cryosphere products from the NPOESS Preparatory Project (NPP).

Association of American Geographers Annual Meeting, 14–18 April 2010, Washington, DC
Karl, T.R.: NOAA Climate Service.
Palecki, M.A.: Insights from Triplicate Measurements of Soil Moisture by the U.S. Climate Reference Network.
Shein, K.A., C. Marzin, T. Brandon, and D. Pirhalla: Development of a climatology for the Florida Keys National Marine Sanctuary.

Third Atmospheric Circulation Reconstructions over the Earth (ACRE) Workshop, November 2010, Baltimore, MD
Freeman, E., H. Anderson, M. Seiderman, and T. Ross: Climate Database Modernization Program-Enhancing the marine environment.
Freeman, E., P. Brohan, C. Wilkinson,and T. Ross:. English East India Company logbooks-Early instrumental marine observations.
Woodruff, S., S. Worley, E. Freeman, C. Wilkinson, and S. Smith: Adding value to ICOADS through data rescue and other enhancements.

Climate and MPA Workshop, 11–13 January 2010, Miami, FL (NOAA)
Marzin, C., K. A. Shein, T. Brandon, D. Pirhalla, B. Keller, and J. Hendee: Climate and marine protected areas: The IMPACT Project.

35th Climate Diagnostics and Prediction workshop, 4–7 October 2010, Raleigh, NC (NOAA)
Hennon, P.A., and K. Knapp: A climatology of infrared-based tropical cyclone wind radii, integrated kinetic energy, and damage potential.
Markham, D., and J. Privette: The Climate Data Record Program and research-to-operations transition process for climate data records.

COAA Fifth International Ocean-Atmosphere Conference, 28–30 June 2010, Taipei, Taiwan
Zhao, X., and E.J. Kearns: Long-term trend of aerosol optical thickness over the Western Pacific Ocean.

Coastal Society's 22nd International Conference, 13–16 June 2010, Wilmington, NC

Hastings, D.: The global Human Security Index: Can disaggregations help us to forge progress?

Hennon, P.A., M.C. Kruk, and D.H. Levinson: Investigating changes in global tropical cyclone storm frequency and intensity.

Kruk, M.C., D.H. Levinson, E.J. Gibney, and P.A. Hennon, 2010: What is coastal climate?

Commission for Climatology XV, February 2010, Antalya, Turkey (WMO)

Peterson, T.C.: Accomplishments of the CCl Open Programme Area Group on monitoring and analysis of climate variability and change. [invited]

17th Conference on Air–Sea Interaction/17th Conference on Satellite Meteorology and Oceanography/Ninth Conference on Coastal Atmospheric and Oceanic Prediction and Processes, 26–30 September 2010, Annapolis, MD (AMS)

Hennon, P.A., and K.R. Knapp: A climatology of infrared-based tropical cyclone wind radii, integrated kinetic energy and damage potential.

Knapp, K.R.: Globally gridded satellite (GriSat) observations for climate studies.

Kruk, M.C., D.H. Levinson, E.J. Gibney, and P.A. Hennon: What is coastal climate?

Levinson, D.H., M.C. Kruk, J. Marra, and E. Gibney: Integrating climate change impacts to improve understanding of coastal climate change: Heavy rains, strong winds, and high seas in coastal Hawai'i, Alaska and the Pacific Northwest.

Semunegus, H., and J.J. Bates: Moving towards an intercalibrated and homogenized SSM/I period of record.

Vila, D.A., R.R. Ferraro and H. Semunegus: A climatology-base scheme for special sensor microwave imager (SSM/I) quality control: An application to monthly rainfall rates.

Zhang, H.-M., L. Shi, and R.W. Reynolds: Surface flux related activities at NOAA National Climatic Data Center.

Zhao, X.: Detection of dust storms from multi-channel satellite imagers.

18th Conference on Applied Climatology, 17–21 January 2010, Atlanta, GA (AMS)

Durre, I., M.J. Menne, B. Gleason, T.G. Houston, and R.S. Vose: Comprehensive automated quality assurance of daily surface observations: The GHCN-daily example.

Heim Jr., R.R.: The floating month drought index -- A new drought monitoring tool.

Heim Jr., R.R.: Trends of U.S. snowfall and snow cover in a warming world, 1948-2008.

Houston, T.G.: Customer satisfaction at NOAA's NESDIS data centers.

Houston, T.G.: User engagement activities at NOAA's National Climatic Data Center.

Kruk, M.C., D.H. Levinson, M.F. Squires, and E.J. Gibney: The climatology of inland winds from tropical cyclones in the eastern United States.

Palecki, M., and C.B. Baker: U.S. climate reference network: A national network monitoring climate change.

Palecki, M., and C.B. Baker: Monitoring drought with the U.S. climate reference network.

Semunegus, H., W. Berg, J.J. Bates, K.R. Knapp, and C. Kummerow: Quality control of SSMI/I data using climatological statistics.

Shein, K.: Evaluation and verification of statewide climate extremes records.

Squires, M.F., J.H. Lawrimore, R.R. Heim, D.A. Robinson, M.R. Gerbush, and T. Estilow: Development of regional snowfall indices.

22nd Conference on Climate Variability and Change, 17–21 January 2010, Atlanta, GA (AMS)

Anderson, D.M.: A perspective on climate and marine biogeochemistry (ocean acidification) change from paleo proxy evidence.

Arguez, A., and R.S. Vose: Alternative normals, version 1.0.

Arndt, D., A. Sánchez-Lugo, J. Crouch, R.R. Heim Jr., C. Fenimore: The climate of 2009 in historical perspective.

Groisman, P.Ya., R.W. Knight, and T.R. Karl: Contemporary climatic changes in North America and Northern Eurasia with foci on extreme events and transitions through environmentally and socio-economically significant thresholds. [Joint with *18th Conference on Applied Climatology*]

Janetos, A., T.C. Peterson, and the GCCI FAC Author Team: Ecosystems impacts.

Kruk, M.C., and K.R. Knapp: Quantifying interagency differences in tropical cyclone best track wind speed estimates.

Kunkel, K.E., D.R. Easterling, B.E. Gleason, D.A.R. Kristovich, R.A. Smith, and L. Ensor: Meteorological features of observed trends in U.S. heavy precipitation events. [Joint with *18th Conference on Applied Climatology*]

Lawrimore, J., B. Gleason, C.N. Williams, M.L. Menne, and W.E. Angel: U.S. and global in situ datasets for the analysis of climate variability and change. [Joint with *26th Conference on Interactive Information and Processing Systems (IIPS) for Meteorology, Oceanography, and Hydrology*]

Meehl, G., C. Tebaldi, G. Walton, D.R. Easterling, and L.R. McDaniel: The relative increase of record high maximum temperatures compared to record low minimum temperatures in the U.S. [Joint with *18th Conference on Applied Climatology*]

Morrill, C., A. Wagner, B.L. Otto-Bliesner, and N. Rosenbloom: Assessing model sensitivity to North Atlantic freshwater perturbations using past abrupt events.

Peterson, T.C., and the SOK FAC Author Team: Key national impacts.

Phillips, M., and D. Eldreth: Multigraph: Interactive data graphs on the web. [Joint with *26th Conference on Interactive Information and Processing Systems (IIPS) for Meteorology, Oceanography, and Hydrology*]

Wahl, E.R., and C.M. Ammann: Examining the forced response of past regional climate to guide selection of general circulation models for regional analyses.

Williams Jr., C.N., M.J. Menne, and M. Palecki: On the reliability of the U.S. surface temperature record.

29th Conference on Hurricanes and Tropical Meteorology, 10–14 May 2010, Tucson, AZ (AMS)

Barnes, H.C., D.J. Vimont and J. Kossin: Analysis of National Hurricane Center track forecast errors based upon geographic location.

Hennon, C.C., C.N. Helms and K.R. Knapp: Toward a global climatology of tropical cloud clusters.

Hennon, P.A., and J. B. Halverson: Ocean-atmosphere interaction effects on tropical cyclone inner-core convective bursts.

Kossin, J.P., S.J. Camargo, and M. Sitkowski: Climate modulation of North Atlantic hurricane tracks: Observations and implications.

Knapp, K.R.: Hurricane reanalysis using Hurricanes Satellite (HURSAT) data.

Kruk, M.C., and K.R. Knapp: Quantifying interagency differences in tropical cyclone best track wind speeds.

Rozoff, C.M., J. Kossin, and D.S. Nolan: Dynamical mechanisms for secondary eyewall formation: insights from a cloud-resolving tropical cyclone model.

Sitkowski, M., J.P. Kossin and C.M. Rozoff: Intensity and structure variations associated with eyewall replacement cycles.

Velden, C.S., C. Rozoff, A. Wimmers, M. Sitkowski, M.E. Kieper, J. Kossin, J. Hawkins, and J. Knaff: An objective method to predict near real time rapid intensification of tropical cyclones using satellite passive microwave observations.

24th Conference on Hydrology, 17–21 January 2010, Atlanta, GA (AMS)

Brewer, M., and J. Symonds: New techniques for climate and drought information delivery at the National Climatic Data Center.

Kim, D., and D.J. Seo: A software package for gauge-only precipitation analysis.

Houborg, R., M. Rodell, J.S. Famigliette, R. Heim, J. Lawrimore, et al.: Toward integrating GRACE terrestrial water storage data into the U.S. and North American Drought Monitors.

26th Conference on Interactive Information and Processing Systems (IIPS) for Meteorology, Oceanography, and Hydrology, 17–21 January 2010, Atlanta, GA (AMS)

Bergmaier, P.T., and K.R. Knapp: Facilitating tropical cyclone analysis of hurricane satellite (HURSAT) imagery with Google Earth.

Crum, T., M.J. Istok, S.A. DelGreco, S. Ansari, and A. Hall: NWS WSR-88D and TDWR-SPG data collection and distribution network status and plans.

Diamond, H.J.: The U.S. Global Climate Observing System (GCOS) program: An update on Continuing efforts to implement reference climate observation sites.

Diamond, H.J., W.F. Roberts, W.R. Seguin, and T.M. Whittaker: More than 25 years of the Interactive Information Processing Systems (IIPS) for Meteorology, Oceanography and Hydrology Conference.

Lief, C.: An update on the Global Observing Systems Information Center (GOSIC) portal: Development of new data access tools.

Lott, J.N., D. Herring, J. Boyd, S. Handel, F. Niepold, and E. Shea: The NOAA climate services portal: A new centralized resource for distributed climate information.

Phillips, M., S. Ansari, and S.A. DelGreco: Severe weather climatologies based on NEXRAD and other data from the Severe Weather Data Inventory (SWDI).

Squires, M.F., R. Baldwin, G. Reid, C. Tabor, and A. Wilson: Development of a GIS snowstorm database.

20th Conference on Probability and Statistics in the Atmospheric Sciences, 17–21 January 2010, Atlanta, GA (AMS)

Timofeyeva, M., A. Hollingshead, S. Handel, M. Ou, J. Gottschalck, M.J. Menne, and C.N. Williams: NOAA local 3-month temperature outlook performance evaluation.

First Conference on Weather, Climate, and the New Energy Economy and *8th Users Forum on Weather and Climate Impacts, 17–21 January 2010, Atlanta, GA (AMS)*

Arguez, A., T. Houston, N. Lott, and J. Blunden: Interacting with energy: A summary of user engagement activities of the energy industry at NOAA's National Climatic Data Center.

Zhang, H.-M., R.W. Reynolds and J.J. Sturman: Multiple satellite blended sea surface winds and their applications to offshore renewable energy.

Creating Surface Temperature Datasets to Meet 21st Century Challenges Workshop, September 2010, Exeter, UK

Peterson, T.C.: Multiple hats, multiple opportunities. [invited]

Worley, S., S. Woodruff, and E. Freeman: ICOADS: A multinational data rescue, digitization, archiving, and access success for the ocean.

Drought Research Initiative, 12–14 May 2010, Winnipeg, Canada

Heim, R.R.: Drought in the USA – Present and past.

Heim, R.R.: From a North American to a global drought monitor.

European Geophysical Union General Assembly, 2–7 May 2010, Vienna, Austria

Nelson, B.R., and D.-J. Seo: Multi-sensor precipitation reanalysis.

Wahl, E.R.: Performance of simulated El Niño-Southern Oscillation climate reconstructions over the last millennium: Comparison of methods.

Third Formal Meeting of the NOAA-Roshydromet MoU, 12–15 July 2010, St. Petersburg, Russia

Shein, K.A., H. Diamond, and A. M. Sternin: Activity 5: Study of climate and management of climatological data exchange.

GCOS Steering Committee Eighteenth Session, September 2010, Geneva

Peterson, T.C.: The Commission for Climatology and GCOS. (given remotely) [invited]

House Select Committee on Energy Independence and Global Warming, 23 September 2010, Washington, DC
Peterson, T.C.: Briefing on extreme weather in a warming world. [invited]

64th Interdepartmental Hurricane Conference, 1–4 March 2010, Savannah, GA
Hennon, P., E. Gibney, K. Knapp, M. Kruk, and D. Levinson: IBTrACS tropical cyclone best track community survey.
Kossin, J.P., M. Sitkowski, and C. Rozoff: A new secondary eyewall formation index: Transition to operations and quantification of associated hurricane intensity and structure changes.

International Climate Change Adaptation Conference: Climate Adaptation Futures, 29 June – 1 July 2010, Gold Coast, Australia
Shein, K.A., C. Marzin, D. Pirhalla, T, Brandon, B. Keller, and J. Hendee: Development of high resolution integrated climatologies for marine protected areas.
Marra, J., D. Atkinson, M. Kruk, D. Levinson, M. Merrifield, P. Ruggiero, and M. Lander: Pacific storms climatologies: Products and applications.

International Coordination of an Interdisciplinary Global Research Infrastructure, 8–9 February 2010, Brussels, Belgium (Science Collections International Conference)
Anderson, D.M.: Climate, environment, and ecosystem change from paleo proxy collections. [invited]
Seventh International Conference on Higher Education and Disability, July 2010, Innsbruck, Austria
Durre, I.: Success for blind students in mathematics and science: The importance of thinking outside the box.

JCOMM- Third Session of the Expert Team on Marine Climatology (ETMC-III), February 2010, Melbourne, Australia
Freeman, J.E.: NOAA's National Climatic Data Center report.
Freeman, J.E., H. Anderson, and M. Seiderman: NOAA's Climate Database Modernization Program marine data rescue projects.

Joint Statistical Meetings, 31 July – 5 August 2010, Vancouver, British Columbia
Wahl, E.: Panel response to 'The value of multiproxy reconstruction of past climate' by Li et al.

Linking Science to Management: A Conference and Workshop on the Florida Keys Marine Ecosystem, 19–22 October 2010, Duck Key, FL
Shein, K.A., C. Marzin, D. Pirhalla, T. Brandon, J. Hendee, and B. Keller: IMPACT: A climate assessment resource for the Florida Keys marine ecosystem.

Meeting of the Americas, 8–12 August 2010, Foz do Iguassu, Brazil (AGU)
Heim, R.R., and M. Brewer: The development of an international drought clearinghouse and its applications to transboundary hydrological basin decisions and research.
Rutledge, G.K.: The NOAA national climate model portal.
Swap, R.J., J.L. Privette, et al.: Remote sensing activities in SAFARI 2000: The complexity of a regional satellite validation campaign in a savanna ecosystem.
Swap, R.J., J.L. Privette, et al.: SAFARI 2000 revisited: What have we learned ten years later concerning regional functioning of savanna ecosystems?

62nd Meeting of the World Meteorological Organization Executive Council, June 2010, Geneva, Switzerland
Peterson, T.C.: The Commission for Climatology. [invited]

National Hurricane Center Seminar Series, July 2010, Miami, FL
Kossin, J.P.: Climatology of intensity and structure changes associated with hurricane eyewall replacement. [invited]

First NOAA User Workshop on the Global Precipitation Measurement (GPM) Mission, August 18–19 2010, College Park, MD
Nelson, B.R., and J Privette: NOAA's CDR program and linkage to GPM.

Ocean Sciences Meeting, 22–26 February 2010, Portland, OR (AGU)

Anderson, D.M.: Seawater carbonate ion concentrations in the Glacial Ocean reconstructed using fossil foraminifer assemblages.

Banzon, P.F., R.W. Reynolds, T. Smith, C. Liu, and D. Wunder: The Extended Reconstruction Sea Surface Temperature (ERSST) analysis: Towards an operational climate product.

Hall, A.D., and E. Kent: The Voluntary Observing Ship Climate Project (VOSClim).

Kearns, E.J., J.L. Privette, J.J Bates, and O.B. Brown: The current status of NOAA's Climate Data Record program.

Kent, E., and A.D. Hall: The Voluntary Observing Ship (VOS) scheme.

Kruk, M.C., D.H. Levinson, and P.A. Hennon: Examining historical tropical cyclones: Uncertainty in extreme winds.

Levinson, D.H., and M.C. Kruk: On the application of climate indices for assessing variability and trends in extreme rainfall across coastal watersheds in the Pacific Northwest.

Reynolds, R.W.: Climate and weather demands on SST accuracy.

Zhang, H.-M., C. Eakin, and J.J. Sturman: Blended and gridded global sea surface winds and their applications in ecosystem and offshore energy.

Oceans from Space Symposium, 26–30 April 2010, Venice, Italy

Banzon, V.F., R.W. Reynolds, and T.M. Smith: The role of satellite data in extended reconstruction of sea surface temperatures.

Marullo, S., R. Santoleri, V. Banzon, R. Evans, and M. Guarracino: Challenges to generating satellite-based diurnal SST fields for the Mediterranean Sea.

Oceans Past III, November 2010, Dublin, Ireland

Woodruff, S., C. Marzin, S. Claesson, E. Freeman, and C. Wilkinson: Rescue and management of historical marine data relevant to biological and climate applications.

2010 Partners in Environmental Technology Technical Symposium & Workshop, 1 December 2010, Washington, DC

Levinson, D.L.: Sea level rise and storms: Observed and predicted changes in storms, climate extremes and impacts. [invited]

Eighth Presidential History Symposium, 17–21 January 2010, Atlanta, GA (AMS)

Freeman, J.E., H. Anderson, and M. Seiderman: NOAA'S Climate Database Modernization Program marine data rescue.

Ross, T.F., and R. Truesdell: NOAA's climate database modernization program–A decade of data rescue and modernization activities.

11th Science Team Meeting (G11) of the Group for High Resolution Sea Surface Temperature (GHRSST), 21–25 June 2010, Lima, Peru

Banzon, V.F., R.H. Evans, R.W. Reynolds, and T.M. Smith: The cold bias in the extended reconstruction of sea surface temperature analysis introduced by the inclusion of Pathfinder V5 data.

Symposium: The Medieval Warm Period Redux - Where and when was it warm?, 22–24 September 2010, Lisbon, Portugal

Wahl, E.R. and H.F. Diaz: New pollen-based reconstructions of summer temperature in central/eastern North America and implications for differences in MCA-LIA circulation patterns.

First Symposium on Environment and Health, 17–21 January 2010, Atlanta, GA (AMS)
Fuhrmann, C.M., M.M. Kovach, J.T. Lutz, P.J. Robinson, D.R. Easterling, T.G. Houston, and W. Thiaw, 2010: Current and future needs of climate data, services, and expertise for the health sector.

15th Symposium on Meteorological Observation and Instrumentation, 17–21 January 2010, Atlanta, GA (AMS)
Palecki, M., and C.B. Baker: Expansion of U.S. climate reference network capabilities.
Wilson, A.M., S. Hinson, D.J. Manns, R. Ray, and J. Lawrimore: Hourly precipitation data processing changes at NCDC.

Fifth Symposium on Policy and Socio-economic Research, 17–21 January 2010, Atlanta, GA (AMS)
Ansari, S., M. Phillips, and S. Del Greco: The severe weather data inventory: A geospatial database of severe weather data at NOAA's National Climatic Data Center (NCDC).
Smith, A.B.: NOAA Economics v2.0 – Mapping & visualization of cost/benefit economics across the United States.

Technical Conference on Changing Climate and Demands for Climate Services for Sustainable Development, February 2010, Antalya, Turkey
Peterson, T.C.: System monitoring and research needs. [invited]
Peterson, T.C., and O. Baddour: WMO climate monitoring capabilities and strategy for development. [invited]

Transportation Research Board 89th Annual Meeting, January 2010, Washington, DC
Peterson, T.C.: What we know and don't know about future climate change in the United States.
U.S. Port Meteorological Officers Meeting, December 2010, Orlando, FL
Hall, A., and E. Freeman: NCDC report to U.S. port meteorological officers.

Western Pacific Geophysics Meeting, 22–25 June 2010, Taipei, Taiwan (AGU)
Zhao, X.: Component aerosol direct radiative effect over the Western Pacific Region.

WCRP-UNESCO Workshop on Metrics and Methodologies of Estimation of Extreme Climate Events, September 2010, Paris, France
Kossin, J.P.: Observed tropical cyclone variability. [invited]

Non-peer reviewed

Bates, J.J., and X.-P. Zhao, 2010: Continuity of Earth Radiation Budget (CERB) observations: Post-CERES requirements. *Earth Observer*, **22(5)**, 21–24.

Bates, J.J, and T.X.-P. Zhao, 2010: *Report for the Workshop on Continuity of Earth Radiation Budget (CERB) Observations: Post-CERES Requirements*. 46 pp.

Finucane, M.L., J. Marra, and J.C. Weyman, 2010: *A Research Strategy for the Pacific Climate Information System* (Working Paper No. 67). Honolulu, HI: East-West Center, 15 pp.

Freeman, J.E., and T.F. Ross, 2010: NOAA's Climate Database Modernization Program (CDMP): Sailing to the future with historical marine observations. *Meteorological Informationbulletin Maritime,* **53(1)**. (Reprint - Originally printed in *Mariners Weather Log* April 2009).

Jones, P., T.C. Peterson, D. Parker, R. Thigpen, and S. Bojinski, 2010: *Guide to the GCOS Surface Network (GSN) and GCOS Upper-Air Network (GUAN)* (2010 Update of GCOS-73). GCOS-144, WMO/TD No. 1558, Global Climate Observing System Secretariat, World Meteorological Organization, Geneva, 28 pp.

Lackey, M., B. Korzeniewski, T. Houston, A. Graumann, J. Kobar, A. Smith, N. Lott, J. Marra, B. Bauer, D. Franklin, D. Brinegar, and S. Veasey, 2010: *Products and Services Guide*. 2010 edition. NOAA's National Climatic Data Center, Asheville, NC, 108 pp.

Levinson, D.H., P.A. Hennon, M.C. Kruk, K.R. Knapp, and H.J. Diamond, 2010: International Best Track Archive for Climate Stewardship (IBTrACS): Synthesizing global tropical cyclone best track data. In: *First WMO International Conference on Tropical Cyclones and Climate Change* (Muscat, Sultanate of Oman, 8-11 March 2009). WMO/TD No. 1541, WWRP 2010-2, World Meteorological Organization, [15 pp.]

Levinson, D.H., K.R. Knapp, M.C. Kruk, H.J. Diamond, and J.P. Kossin, 2010: The International Best Track Archive for Climate Stewardship (IBTrACS) Project: Overview of methods and Indian Ocean statistics. IN: *Indian Ocean Tropical Cyclones and Climate Change*, Y. Charabi, Ed. Springer Netherlands, pp. 215–221.

National Climatic Data Center, 2010: *Billion Dollar U.S. Weather Disasters, 1980-2009*. [Online] NOAA's National Climatic Data Center, Asheville, NC. http://www.ncdc.noaa.gov/oa/reports/billionz.html

Supported research:

Bulygina, O.N., P.Ya. Groisman, V.N. Razuvaev, and V.F. Radionov, 2010: Snow cover basal ice layer changes over Northern Eurasia since 1966. *Environmental Research Letters*, **5**, 015004, doi:10.1088/1748-9326/5/1/015004. [Groisman: UCAR Visiting Scientist]

Christy, J.R., R.W. Spencer and W.B. Norris (deceased), 2010: The role of remote sensing in monitoring global bulk tropospheric temperatures. *International Journal of Remote Sensing*. (in press.) [University of Alabama, Huntsville; Christy: PI]

Christy, J.R., B. Herman, R. Pielke, Sr., P. Klotzbach, R.T. McNider, J.J. Hnilo, R.W. Spencer, T. Chase and D. Douglass, 2010: What do observational datasets say about modeled tropospheric temperature trends since 1979? *Remote Sensing*, **2**, 2148–2169. [University of Alabama, Huntsville; Christy: PI]

Christy, J.R. and J.J. Hnilo, 2010: Changes in snowfall in the Southern Sierra Nevada Mountains of California since 1916. *Energy and Environment,* **21**, 223–234. [University of Alabama, Huntsville; Christy: PI]

Groisman, P., G. Gutman, and A. Reissell, 2011: Climate and land-cover changes in the Arctic. In: *Eurasian Arctic Land Cover and Land Use in a Changing Climate*. G. Gutman and A. Reissell (eds.). Springer, pp. 1-8. [Groisman: UCAR Visiting Scientist]

Groisman, P. Ya., S. Ivanov, S. Mátyás, A. Meshcherskaya, and V. Razuvaev: Northern Eurasia Earth Science Partnership Initiative (NEESPI): Focus on dry lands. *AGU Fall Meeting*, 13–17 December 2010, San Francisco, CA. [Groisman: UCAR Visiting Scientist]

Klotzbach, P.J., R.A. Pielke Sr., R.A. Pielke Jr., J.R. Christy, and R.T. McNider, 2010: Correction to "An alternative explanation for differential temperature trends at the surface and in the lower troposphere". *Journal of Geophysical Research*, **115**, D01107, doi:10.1029/2009JD013655. [University of Alabama, Huntsville; Christy: PI]

Palamarchuk, J., S. Ivanov, P.Ya. Groisman, and G. Ivus: Regional changes of precipitation and runoff in Eastern Europe. *AGU Fall Meeting*, 13–17 December 2010, San Francisco, CA. [Groisman: UCAR Visiting Scientist]

Rawlins, M.A., M.Steele, M.M. Holland, J.C. Adam, J.E. Cherry, J.A. Francis, P.Ya. Groisman, et al., 2010: Analysis of the Arctic system for freshwater cycle intensification: observations and expectations. *Journal of Climate*, **23**, 5715–5737. [Groisman: UCAR Visiting Scientist]

Razuvaev, V., P. Ya. Groisman, O. Bulygina, and I. Borzenkova: Extreme heat wave over European Russia in summer 2010: Anomaly or a manifestion of climate trend? *AGU Fall Meeting*, 13–17 December 2010, San Francisco, CA. [Groisman: UCAR Visiting Scientist]

Shi, X., P.Ya. Groisman, S.J. Dery, and D.P. Lettenmaier, 2010: Relationships between recent snow cover extent and hydroclimatic changes over the pan-Arctic. *AGU Fall Meeting*, 13–17 December 2010, San Francisco, CA. [Groisman: UCAR Visiting Scientist]

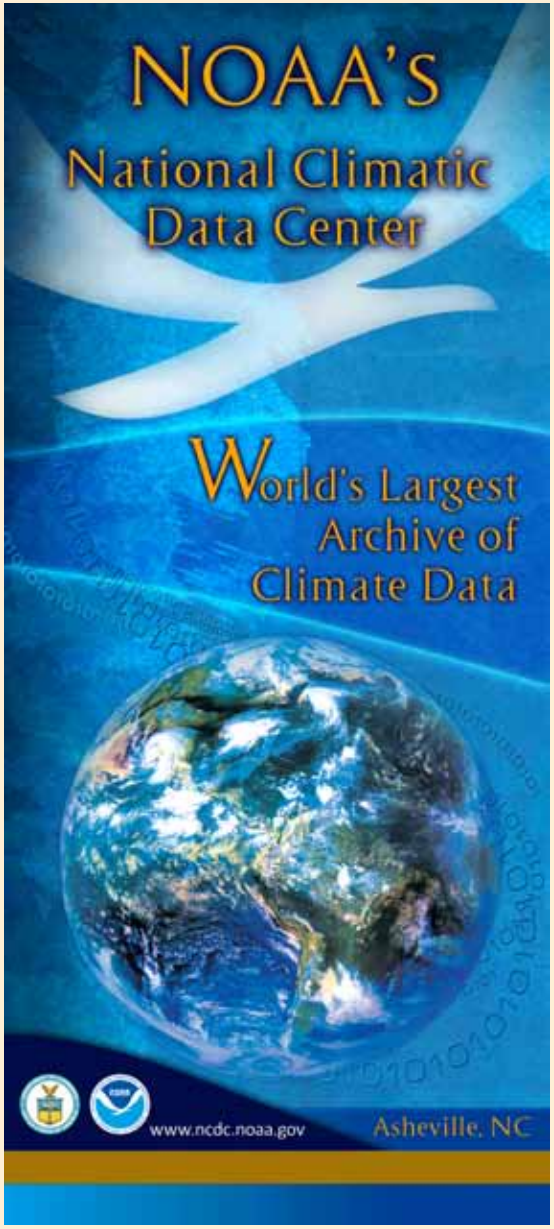
Spencer, R.W., and W.D. Braswell, 2010: Phase space analysis of climate forcing and feedback in model simulations and satellite observations. *Journal of Geophysical Research,* **115**, D16109, doi:1029/2009JD013371. [University of Alabama, Huntsville; Christy: PI]

Stroumentova, N., P.Ya. Groisman, R.W. Knight, T.R. Karl, 2010: Changes in intense precipitation over the conterminous U.S. *AGU Fall Meeting*, 13–17 December 2010, San Francisco, CA. [Groisman: UCAR Visiting Scientist]

Zhang, X., J. Wang, F. Zwiers, and P.Ya Groisman, 2010: The influence of large-scale climate variability on winter maximum daily precipitation over North America. *Journal of Climate*, **23**, 2902–2915. [Groisman: UCAR Visiting Scientist]

Our mission is to provide access and stewardship to the Nation's resource of global climate- and weather-related data and information, and assess and monitor climate variation and change.

This effort requires the acquisition, quality control, processing, summarization, dissemination, and preservation of a vast array of climatological data generated by the national and international meteorological services. NCDC's mission is global in nature and provides the U.S. climate representative to the World Meteorological Organization, the World Data Center System, and other international scientific programs. NCDC also operates several World Data Centers, including meteorology and paleoclimatology.



CREDITS

Editors: Katy Vincent and Brian Nelson

Layout and artistic design: Deborah Riddle
Technical support: Sara Veasey
Bibliography: Mara Sprain

A special thank you to:
NCDC Staff for their input and review
NCDC Graphics Team

National Oceanic and Atmospheric Administration
National Environmental Satellite, Data, and Information Service
National Climatic Data Center
Asheville, North Carolina 28801

Phone: 828-271-4800 * TDD 828-271-4010
Fax: 828-271-4876
www.ncdc.noaa.gov